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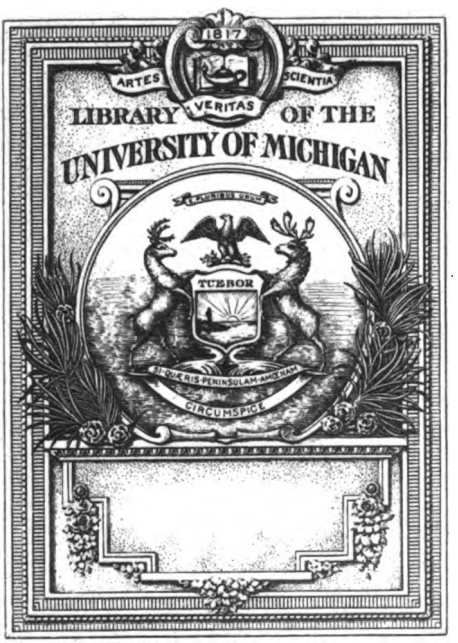
Fig. 3.—Case 115,553. (Prior to third operation.) Some irregularit
f stoma and jejunum at *a*; niche of gastric ulcer on lesser curvatu
t *b*; hour-glass constriction at *c*.



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TRANSACTIONS OF THE

American medical association.

SECTION ON

SURGERY

General and Abdominal

of the
American Medical Association
at the Sixty-Sixth Annual
Session, held at San Francisco,
June 22 to 25, 1915

AMERICAN MEDICAL ASSOCIATION PRESS
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PROCEEDINGS OF THE SECTION

TUESDAY, JUNE 22—AFTERNOON

The meeting was called to order at 2:15 by the chairman, Dr. Charles H. Peck, New York.

Dr. M. Estes, chairman of the American Surgical Association, presented the following resolution:

Resolved, That the Surgical Section heartily recommend the standard form of fracture report submitted by the American Surgical Association; and be it further

Resolved, That the section present this standard form of fracture report to the House of Delegates with the request that it be adopted as the standard form of fracture report by the American Medical Association.

The resolution was duly seconded, and, without discussion, carried.

[Concerning the above resolution, in the House of Delegates, Thursday afternoon, June 24, Dr. Dean Lewis, Delegate from the Section on Surgery, asked unanimous consent, which was granted, to introduce the following, which was referred to the Board of Trustees:

At the meeting of the American Surgical Association the Committee on Fractures made the following explanations and recommendations:

The work of this committee has been greatly hampered by the inadequacy of the records submitted for its consideration. A large proportion of the cases had to be rejected entirely, and most of them were so incomplete as to make deductions based upon them possibly misleading.

The first step in the betterment of practice is the study of results achieved by present day methods. An adequate study is impossible without adequate records.

The committee strongly urges the American Surgical Association to set its seal of approval upon the standard form of record submitted by the committee, and to further petition the American Medical Association to do the same. The committee also urges each member of this Association faithfully to keep these records in his practice and to see that they are kept in the hospitals to which he is attached.

The committee further recommends that a copy of the approved form be sent to all corporations within the United States of sufficient importance to have their own relief organizations or medical service or both, to all accident insurance companies to be embodied and incorporated in the papers given to the insured, with the requirement that they be filled at the time of an accident involving fracture; to all

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hospital boards with the request that these records be made a part of the routine records of fracture patients, pointing out that thus not only are the hospital and its surgeons protected in case of litigation, but that most valuable material is being collected to serve for attaining better results in the treatment of fractures.

The American Surgical Association adopted the report and recommendations and now especially petitions the American Medical Association to do the same.

The following resolution is, therefore, submitted to the Surgical Section: (Then follows the resolution given above.)]

Dr. Peck then read the chairman's address, entitled "Benign Lesions of Stomach and Duodenum, with Special Reference to Late Operative Results." No discussion.

Dr. W. J. Mayo, Rochester, Minn., read a paper on "Chronic Gastric Ulcer." No immediate discussion.

Dr. A. J. Ochsner, Chicago, read a paper on "The Relation Between Chronic Ulcer and Cancer of the Stomach." Discussed by Drs. Emmet Rixford, San Francisco; William L. Rodman, Philadelphia; W. I. Terry, San Francisco; Miles F. Porter, Fort Wayne, Ind.; A. E. Rockey, Portland, Ore.; J. Chris O'Day, Portland, Ore., and C. G. Levison, San Francisco.

Dr. R. D. Carman, Rochester, Minn., read a paper by himself and Dr. D. C. Balfour, Rochester, Minn., on "Gastrojejunal Ulcers: Their Roentgenologic and Surgical Aspects." No discussion.

Dr. J. Rilus Eastman, Indianapolis, read a paper on "Surgical Anatomy of Cleft Palate." Discussed by Drs. Harry Sherman, San Francisco; Charles D. Lockwood, Pasadena. Calif.; Charles H. Peck, New York; George V. I. Brown, Milwaukee, Wis., and J. Rilus Eastman, Indianapolis.

The chairman announced that as Drs. Edward Martin, Philadelphia, and Arthur D. Bevan, Chicago, were absent, the section would have the papers of Drs. Rea Smith, Los Angeles, and O. M. Shere, Denver, read.

Dr. Rea Smith, Los Angeles, read a paper on "Ileocolostomy and Colectomy for Arthritis Deformans." Discussed by Drs. J. F. Percy, Galesburg, Ill., M. Casper, Louisville, Ky., and Rea Smith, Los Angeles.

Dr. O. M. Shere, Denver, read a paper on "Myositis Ossificians Traumatica." Discussed by Drs. Otis F. Lamson, Seattle; D. D. Lewis, Chicago; Alexius McGlannan, Baltimore, and O. M. Shere, Denver.

Thursday, June 24—Morning

Dr. Dean D. Lewis, Chicago, read a paper by himself and Dr. E. G. Kirk, Chicago, on "Fascial Tubulization in Repair of Nerve Defects—An Experimental Study." Discussed by

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Drs. A. A. Law, Minneapolis; John Golden, Chicago; Kenith MacKenzie, Portland, Ore.; F. W. Rinkenberger, Los Angeles, and Dean D. Lewis, Chicago.

The following officers were elected: Chairman, Dr. E. W. Andrews, Chicago; Vice Chairman, Dr. Fred. Murphy, St. Louis; Secretary, Dr. E. S. Judd, Rochester, Minn.; Orator, Dr. Emmett Rixford, San Francisco; Delegate, Dr. Dean D. Lewis, Chicago; Alternate, Dr. W. D. Haggard, Nashville, Tenn.

Dr. W. B. Russ, San Antonio, Tex., read a paper on "Selection of Operative Cases in Chronic Intestinal Stasis." Discussed by Drs. J. N. Jackson, Kansas City, Mo.; Robert Coffey, Portland, Ore.; Rea Smith, Los Angeles; F. W. Rinkenberger, Los Angeles, Robert T. Morris, New York; J. W. Draper, New York, and W. B. Russ, San Antonia, Texas.

Dr. W. B. Brinsmade, Brooklyn, read a paper on "Intestinal Adhesions." Discussed by Drs. A. S. Lobingier, Los Angeles; A. F. Jonas, Omaha; L. S. Pilcher, Brooklyn; W. I. Terry, San Francisco, and J. W. Draper, New York.

Dr. H. Beeckman Delatour, Brooklyn, read a paper on "Malignant Diseases of the Large Intestine."

Dr. D. F. Jones, Boston, read a paper on "Combined Abdominal and Sacral Operation for Carcinoma of the Rectum."

These two papers were discussed by Drs. Miles F. Porter, Fort Wayne, Ind.; C. B. Davis, Chicago; Alexius McGlannan, Baltimore; Louis J. Hirschmann, Detroit; Robert Coffey, Portland, Ore.; John Rawson Pennington, Chicago; H. Beeckman Delatour, Brooklyn, and D. F. Jones, Boston.

Dr. A. E. Rockey, Portland, Ore., read a paper on "The Transverse Incision in Operations for Appendicitis." Discussed by Drs. Robert Emmett Farr, Minneapolis; A. V. Moschcowitz, New York; J. Chris O'Day, Portland, Ore.; O. O. Witherbee, Los Angeles, and A. E. Rockey, Portland, Ore.

THURSDAY, JUNE 24—AFTERNOON

Dr. Samuel J. Mixter, Boston, read the Oration on Surgery, entitled "The Intestinal Tract.

Dr. J. T. Case, Battle Creek, Mich., read a paper on "Postoperative Roentgen Studies in Gastric and Intestinal Operations." No discussion.

Dr. F. H. Albee, New York, read a paper on "The Use of Inlay and Dowel Grafts in the Treatment of Fractures." Discussed by Drs. E. W. Ryerson, Chicago; John Golden, Chicago; Thomas W. Huntington, San Francisco, and F. H. Albee, New York.

Dr. J. F. Corbett, Minneapolis, read a paper on "The Suprarenal Gland in Shock." Discussed by Drs. J. E. Moore, Minneapolis, and J. F. Corbett, Minneapolis.

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Dr. Bransford Lewis, St. Louis, read a paper on "Cystoscopic Methods in Ureteral Stricture and Calculus." Discussed by Drs. W. F. Braasch, Rochester, Minn.; L. W. Bremerman, Chicago, and Bransford Lewis, St. Louis.

Dr. Robert Abbe, New York, read a paper on "Roentgen-Ray Epitheliomas Curable by Radium—An Apparent Paradox." No discussion.

The following papers were read as a Symposium on War Surgery:

Dr. Wesley Earle Drennen, Birmingham, Ala.: "Experiences in Military Surgery."

Dr. F. E. McCullough, U. S. Navy, San Francisco: "Casualties of Modern Naval Warfare."

No discussion.

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BENIGN LESIONS OF THE STOMACH AND DUODENUM

THE CHOICE OF SURGICAL PROCEDURE WITH SPECIAL REFERENCE TO LATE RESULTS *

CHARLES H. PECK, M.D.
NEW YORK

The surgical treatment of benign lesions of the stomach and duodenum is one of the most important problems of abdominal surgery. The brilliant work of contemporary surgeons has demonstrated that such lesions are curable, in the majority of instances, by properly selected surgical procedures, and that restoration to health may be perfect and permanent. That this happy result fails of achievement in some instances places a burden of heavy responsibility on one who, in case of failure, must review his procedure, and determine whether the fault lies in any error of judgment in selecting the mode of treatment, or failure in the execution of some point in technic.

A brief review, therefore, of the methods in vogue for the treatment of these lesions, seems not amiss; for while much in the line of standardization has been accomplished, much remains to be done. It is not my intention to give even a brief historical review of the surgery of benign lesions of the stomach and duodenum. All honor is due to the able and brilliant pioneers in this field who have blazed the trail, and the limitations of space will not permit of an attempt to do them justice. To the active surgeons of our own time, however, history will give credit for the work which has put surgery on a sound and practical basis, and has made safe and a matter of routine, operations which,

* Chairman's Address.

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a few brief years ago, were hazardous in the extreme and uncertain of outcome.

Here, again, I must beg indulgence if in mentioning the Mayos, Ochsner, Murphy, Rodman, Deaver, Finney — names inseparably connected with the most valuable advances in stomach surgery — I omit many others who well deserve mention on this honor roll. To Weir belongs the credit of being the first to call attention to the occurrence and probable frequency of duodenal ulcer years before its great importance was clearly recognized.

While lesions of the stomach and duodenum have much in common, and much confusion of reports and of symptoms has existed in the past, duodenal ulcer now occupies a position of its own and is recognized as the most common and, in many ways, the most important lesion of the upper gastro-intestinal tract. Of its occurrence, pathology, and symptoms I shall say nothing, as these features have been exhaustively discussed. The vital question, after all, after the diagnosis has been made, the abdomen opened, and the lesion demonstrated, is: What shall be the choice of operative procedure to cure the disease and effect a permanent restoration of the patient to health?

It is difficult to appreciate what the past few years have done for the surgery of benign lesions of the stomach and duodenum. In analyzing the case records of the past five years at the Roosevelt Hospital, one is impressed by the increasing confidence with which the various benign lesions are approached surgically, and the more definite rules of procedure which have been gradually evolved.

I shall speak chiefly of procedures which have actually been used in this series of cases, and the results which have been a matter of personal observation. A study of our records shows that simple gastro-enterostomy has been the routine treatment of chronic ulcer of the duodenum, and that pyloric exclusion or excision of the ulcer has rarely been resorted to.

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While much has been written for and against it, gastro-enterostomy still remains the operation of choice, either with or without some form of pyloric exclusion, and I shall consider whether the late results of this operation justify this choice. A preliminary word as to the reason why this seemingly inadequate procedure is capable of effecting a cure of the disease.

The two theories most commonly advanced are drainage and chemical effect. It is my opinion that both are factors, and that they are to some extent interdependent.

Certain it is that the clinical result in a goodly percentage of cases of uncomplicated chronic duodenal ulcer is most gratifying, especially the late results. Cannon and Blake[1] demonstrated by animal experimentation in 1905 that a gastro-enterostomy opening would in time close if the pylorus remained patent, and from their results the conclusion has been drawn that this would occur in the human body, as a rule, when gastro-enterostomy was done without pyloric occlusion.

The late results in our series may be of some interest, therefore, as bearing on the question of permanency of the artificial opening and the cure of this condition by simple gastro-enterostomy without pyloric exclusion.

I have collected a number of roentgenographic late observations, some of them more than four years after gastro-enterostomy, which seem to prove that this reasoning is fallacious, for the majority of the gastro-enterostomy openings are functionating in spite of a pylorus known to be patent and not occluded at the time of operation.

The fact that the patency of the stoma is accompanied by relatively rapid emptying of the stomach, and that these cases show a perfect clinical cure, would seem to support the view that drainage is an important element in the cure of these cases.

1. Cannon and Blake: Ann. Surg., 1905, xli, 686.

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One hundred and thirty-four patients with gastric and duodenal ulcer have been operated on by the surgical staff of the hospital since Jan. 1, 1910. A definite macroscopic lesion was demonstrated in every case of the series, and in all but one, some definite surgical procedure was undertaken for its relief.

The cases were distributed as follows:

Chronic duodenal ulcer	74
Chronic gastric ulcer	24
Gastric ulcer with hour-glass stomach	6
Perforated duodenal ulcer (acute)	17
Perforated gastric ulcer (acute)	13
Total	134

The operative procedures employed were:

Simple gastro-enterostomy for	
Chronic duodenal ulcer	72
Chronic gastric ulcer	13
Hour-glass stomach	1
Perforated duodenal ulcer	12
Perforated gastric ulcer	4
Total	102
Gastro-enterostomy with excision of ulcer for	
Chronic gastric ulcer	3
Chronic duodenal ulcer (pylorectomy)	1
Gastro-enterostomy with pyloric exclusion (secondary) for	
Chronic duodenal ulcer	1
Gastro-enterostomy with cautery puncture for	
Chronic gastric ulcer	1
Gastro-enterostomy with gastroplasty for	
Hour-glass stomach	1
Total	7
Excision of ulcer without gastro-enterostomy for	
Gastric ulcer	2
Partial gastrectomy for	
Gastric ulcer	3
Transgastric resection for	
Gastric ulcer	1
Suture of perforation without gastro-enterostomy for	
Perforated duodenal ulcer	5
Perforated gastric ulcer	9
Gastrogastrostomy for	
Hour-glass stomach	1
Gastroplasty for	
Hour-glass stomach	3
Exploratory celiotomy for	
Chronic gastric ulcer	1
Total	25

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It will be seen, therefore, that gastro-enterostomy alone was performed 102 times; and, combined with some form of excision of the ulcer or other surgical procedure, except partial gastrectomy, 7 times; that is, it was the essential part of the operation in 109 cases. In the remaining 25 cases a number of different procedures were employed.

CHRONIC DUODENAL ULCER

We will consider first the results obtained in the chronic duodenal ulcers, 74 in number (72 of which were treated by simple gastro-enterostomy). Six of the patients died following operation — a mortality of 8.1 per cent. It should be remembered that this is the mortality in an unselected group of cases treated in a general service by a number of different operators, but as we are especially interested in the late results in the patients who survived, I shall not dwell on the causes of operative deaths.

Two of the remaining 68 patients died subsequently, too soon to estimate operative results — one of pulmonary tuberculosis, lighted up by the operation; one of pneumonia shortly after leaving the hospital. One patient met accidental death by drowning three and a half years after operation, having been completely cured of his gastric symptoms in the meantime.

Of the 65 remaining cases, we have been able to trace all but 7.

Fifty-eight cases are available, therefore, for a study of late results, and of these 51 patients are completely cured and free from their former gastric symptoms. Five are improved, but still have pain and indigestion at times, and two are unimproved. Of the total number of patients operated on, therefore, 68.9 per cent. are cured, and if one reckons from the number of cases actually traced, 88 per cent. have good results and 12 per cent. poor results.

Let us turn for a moment to the results of other clinics: Küttner,[2] from a study of 1,100 cases of sur-

2. Küttner: Arch. f. klin. Chir., 1914, cv, 789.

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gical conditions of the stomach and duodenum treated in the past seven years, says that the permanent results of gastro-enterostomy for ulcer of the stomach and duodenum, including those in the vicinity of the pylorus, or at a distance from it, were extremely favorable. He gives 65 per cent. of complete cures and 20 per cent. of very essential improvement. He includes in his study, cases of active ulcer, pyloric stenosis and hourglass stomach. He also states that the functioning of the stoma was determined by late roentgenoscopy, and that it was excellent except in a few cases, which gave also unfavorable clinical results. He believes positively that gastro-enterostomy functionates in the presence of an open pylorus, and states that the findings in animal experimentation do not apply to man. His reexamination caused great doubt in his mind as to whether artificial constriction of the pylorus actually yielded better results than simple gastro-enterostomy.

He noted that in three cases of hemorrhage after operation, only one followed simple gastro-enterostomy, the other two following total pyloric exclusion, and concludes with the statement that simple gastro-enterostomy is one of the most beneficial operations known to surgery.

I have quoted Küttner somewhat fully because of the great amount of material from which his conclusions were drawn; his recognized standing as one of the ablest surgeons on the continent, and because his views express so well our own conclusions, both as to the permanency of a properly constructed gastro-enterostomy opening in the presence of a patent pylorus, and as to the favorable clinical results of simple gastro-enterostomy. Küttner attributes the favorable remote results in gastro-enterostomy to the excellent functioning of the gastro-enterostomy opening, and considers the essential feature the rapid evacuation of the stomach; which was always a marked feature in our own late roentgenoscopies.

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Hartmann,[3] in an able summary of the subject presented before the last meeting of the International Surgical Society in New York, states that the widespread belief that the gastro-enterostomy opening is functionless in the presence of a permeable pylorus, and usually undergoes cicatricial closure, is a fallacy, and gives the results both of animal experimentation and roentgenoscopies to prove that when the opening is at the pyloric antrum and not at the fundus, it remains permeable and functionates whether the pylorus is patent or not.

There has been a tendency by some surgeons to belittle this drainage feature, and to attribute all beneficial results to chemical changes in gastric secretions. While this undoubtedly is a factor, late gastric analyses have failed to establish very marked changes in the acidity of gastric chemistry, and such benefit as may be attributed to the chemical changes is more probably due to the fact that acid secretions remain in the stomach a shorter time and in smaller amount, than that the chemical character of the secretions is greatly changed. Also, in the case of duodenal ulcer, the gastric contents, instead of being projected in spurts directly against the ulcerated surface, leave the stomach chiefly via the stoma.

Brun[4] believes that the best results follow gastro-enterostomy at or near the pyloric antrum rather than at the fundus, and speaks especially of the "motor unrest" of a stomach with a gastro-enterostomy opening far to the left, and also in the presence of artificial closure of the pylorus, due to the constant effort of the stomach to overcome the obstruction. He believes that gastro-enterostomy properly placed gives excellent results in ulcer, and that the proper place is at or near the pyloric antrum, where the stomach normally propels the food for evacuation.

3. Hartmann: Ann. Surg., 1914, lix, 835.
4. Brun, H.: Deutsch. Ztschr. f. Chir., 1915, cxxxii, 566.

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Von Eiselsberg[5] favors his method of pyloric exclusion in pyloric or duodenal ulcer, but his series, up to the time of the report (thirty-six cases) showed no better results than simple gastro-enterostomy.

Sherren[6] speaks strongly in favor of simple gastro-enterostomy for duodenal ulcer, and does not believe in excluding the pylorus. Kocher[7] also favors simple gastro-enterostomy, and believes that pyloric exclusion is not only inadvisable, but probably harmful. Pessimistic views are not wanting, on the other hand, Jianu[8] and Zweig[9] believing that the results of gastro-enterostomy are mediocre. Our feeling in regard to pyloric exclusion is based more on reports or, rather, absence of reports which would seem to prove its desirability, than on our own experience, which is practically nil. In the one case in our series (Case 1033) the patient had recurring pain and hemorrhage after pyloric exclusion, just as he had had after gastro-enterostomy, while a high percentage of the simple gastro-enterostomies have been completely cured.

In one case only of duodenal ulcer, pylorectomy was performed for multiple ulcers of the chronic perforating type, as sharp hemorrhage had occurred, and recurrence was feared. This patient, operated on only four months ago, is quite well and relieved of distressing symptoms of long standing.

For nonperforating, chronic duodenal ulcer, therefore, we believe that simple gastro-enterostomy is an effective and safe procedure, and should be the operation of choice; that there is no evidence that the addition of pyloric exclusion will give better results; that a properly constructed stoma will functionate and remain patent for years in spite of an open pylorus, and that the drainage feature of a functionating gastro-enterostomy opening is an important factor in effecting and maintaining cure of the ulcer.

5. Von Eiselsberg: Surg. Gynec. and Obst., 1914, xix, 555.
6. Sherren: Surg., Gynec. and Obst., 1914, xix, 564.
7. Kocher: Deutsch. Ztschr. f. Chir., 1912, cxvi, 183.
8. Jianu: Wien. klin. Wchnschr., 1910, cxvi, 1223.
9. Zweig: Arch. f. Verdauungskr., 1913, xix, 740.

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As in no case of this series has the patient been treated by Finney's method of pyloroplasty, I am not able to comment on this procedure from actual observations, but appreciate the arguments in its favor so well presented by Finney[10] in his recent report of results in one hundred cases.

I am also unable to comment on the occurrence of jejunal ulcer as a late complication following gastro-enterostomy, as no case of this lesion has occurred in our series, or, at least, none have been recognized.

CHRONIC GASTRIC ULCER

Our feeling in regard to simple gastro-enterostomy in gastric ulcer at a distance from the pylorus has been somewhat different. The well-known tendency of these ulcers to undergo malignant degeneration, together with the fact that a greater percentage fail to heal after simple gastro-enterostomy, has made us feel the desirability of excising such ulcers when it could safely be done.

Clairmont's statistics from von Eiselsberg's clinic[5] illustrate well the less favorable results, though many operators take a much more optimistic view, notably Sherren,[6] whose late results in a long series of unexcised gastric ulcers failed to show a single case in which carcinoma had developed.

Our series includes thirty cases of gastric ulcer, in six of which there was hour-glass contraction. The operative procedures were distributed as follows:

Simple gastro-enterostomy	13
Local excision with gastro-enterostomy	3
Local excision without gastro-enterostomy	2
Partial gastrectomy	3
Cautery puncture with gastro-enterostomy	1
Transgastric resection	1
Gastrogastrostomy (hour-glass)	1
Gastroplasty (hour-glass)	4
Gastro-enterostomy (hour-glass)	1
Exploratory celiotomy	1
Total cases	30

10. Finney: Surg., Gynec. and Obst., 1914, xviii, 273.

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Six cases of hour-glass stomach are included in the series. One gastrogastrostomy patient is well, four and one-half years after operation, and a recent roentgenogram shows rapid emptying of the cardiac pouch, and a good functioning of the artificial stoma. One patient with gastro-enterostomy in the cardiac pouch soon returned without relief of symptoms, and was later lost track of. In four recent cases the patients are relieved of symptoms to date: three were treated by gastroplasty alone, one by gastroplasty with gastro-enterostomy.

Of the thirteen patients with gastric ulcers treated by simple gastro-enterostomy, two died following operation, and two subsequently; one was unimproved, and developed carcinoma a year later; one with an extensive ulcer of the lesser curvature, showed only a moderate improvement one year later and seven are entirely cured of symptoms at intervals of from five and a half years to seven months.

In the two cases of excision of ulcer of the lesser curvature without gastro-enterostomy, one patient is perfectly well two and a half years later; the other continued to have symptoms, and returned three years later with extreme cachexia and probably carcinoma.

In the three cases of local excision of the ulcer with gastro-enterostomy, one patient died after operation following secondary operation for persistent vomiting; the other two patients—recent cases—are completely relieved of symptoms after a smooth operative recovery.

In the three cases of partial gastrectomy (Billroth No. 2) two patients are completely relieved of symptoms at two years, ten months, and three years, three months, respectively. One patient, in a difficult case of an ulcer near the cardia, died following the operation. One patient, treated by Balfour's method of cautery puncture and gastro-enterostomy, is quite well after six weeks, and in one case of transgastric resection the patient is well after three months.

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Our results in this series of thirty cases of chronic gastric ulcers and their sequelae, therefore, are much less favorable than those in the duodenal group, and the series is too short, and many of the cases too recent, to make our deductions of much value.

The higher mortality of simple gastro-enterostomy in gastric ulcer was due more to the pathologic condition present than to the operative procedure, one of the two immediate deaths being in a cachectic old man with a huge ulcer of the posterior wall, and extreme cachexia, in whom I made the ill-advised attempt at operative relief by performing anterior gastro-enterostomy. The case should have been considered inoperable. Death occurred on the third day from post-operative pneumonia.

The other two deaths in the series occurred, one after local excision of the ulcer with gastro-enterostomy, the other after a difficult partial gastrectomy. Two patients died subsequently: one a year later, apparently cured of his gastric symptoms; one from pneumonia shortly after leaving the hospital.

In two cases of the series the patients developed carcinoma later, one after simple gastro-enterostomy for ulcer near the pylorus, the other after local excision of the ulcer of the lesser curvature, without gastro-enterostomy.

In seventeen of the cases the patients are well and quite relieved of symptoms, though of this number five were operated on too recently to be classed as permanently cured.

To summarize our conclusions, therefore, in regard to the treatment of chronic gastric ulcer, we believe that when the ulcer is at or near the pylorus, pylorectomy (Rodman's operation) is probably the ideal procedure; when on the lesser curvature, in the pyloric or middle third, local excision, with or without gastro-enterostomy; cautery puncture (Balfour) either with or without gastro-enterostomy; transgastric resection, or partial gastrectomy (Billroth No. 2, or Polya's

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method) are the procedures from which to choose, that is, some method of excision of the ulcer rather than simple gastro-enterostomy.

Of these various methods we believe that local excision, combined with gastro-enterostomy, is probably the method of choice. Local excision without gastro-enterostomy shortens the lesser curvature and causes some distortion of the stomach, and probably interferes with its normal peristalsis and propulsion of food through the pylorus. We believe, therefore, that an added gastro-enterostomy at the pyloric antrum will give better drainage and probably better clinical results.

When the ulcer is on the lesser curvature, so near the cardia that excision would be difficult and hazardous, cautery puncture, with or without gastro-enterostomy, is a valuable addition to the possible methods of procedure.

Transgastric resection is spoken of very favorably by von Eiselsberg[5] and by Kummell;[11] and in my one case of this procedure, I was much pleased both with the immediate results and the complete relief of symptoms. The case is too recent to have late results of value as yet.

When, as was the case in two of our simple gastro-enterostomies, the ulcer is too extensive to allow of resection, gastro-enterostomy can at best be considered only a palliative measure. In one of these cases, already referred to, the patient died immediately; the other showed little, if any improvement at the end of a year.

In regard to transgastric resection, Kummell[11] reports eighteen cases with two operative deaths, and speaks of it as a severe operation, remarkably well tolerated, and suitable for ulcers situated in the middle of the stomach. In nine of these cases which were followed the patients were entirely well and able to

11. Kummell: Centralbl. d. ges. Chir. u. Grenzgeb., 1914, v, 743.

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work. Von Eiselsberg[5] reports twelve cases with four deaths, and is also favorably impressed with the results of this operation. It is, however, a severe procedure, the mortality of which will probably be higher than that of local excision, with or without gastro-enterostomy.

PERFORATED DUODENAL AND GASTRIC ULCER

There were seventeen cases of acute perforated duodenal ulcer in the series, with two operative deaths, one due to subphrenic abscess and one to post-operative pneumonia. In one of the fatal cases gastro-enterostomy was performed, and was not drained (death from pneumonia). In the other, the perforation was sutured; drainage was used and no gastro-enterostomy was done (death on the twenty-second day from subphrenic abscess). No patient died of extension of the peritonitis. Primary gastro-enterostomy was performed in twelve of the seventeen cases. Two patients died subsequently, shortly after leaving the hospital; one of hemorrhage, one of pulmonary tuberculosis.

In the thirteen remaining cases, seven patients are cured and free from symptoms; three after four years, one after three years, three more than two years. Five are improved, but have more or less indigestion and pain, and one is untraced. Of the five patients who still suffer from pain and indigestion, four had primary gastro-enterostomy performed, and one a simple suture of the perforation. Of the cured patients five had gastro-enterostomy and two did not. Conclusions as to the effect of gastro-enterostomy on the permanent cure of symptoms in this group, therefore, are not of much value. It would seem fair to assume, however, that primary gastro-enterostomy in properly selected cases does not greatly increase the immediate mortality, and that it should increase the prospects of ultimate cure. None of the cases of this series, treated by simple suture without gastro-enterostomy, however, have required secondary operations for pyloric stenosis.

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In the thirteen cases of acute perforated gastric ulcer, six patients died following operations, all with extensive generalized peritonitis, one having pneumonia, one subphrenic abscess, and one delirium tremens in addition to the peritonitis. Gastro-enterostomy was performed in five of the seven patients who recovered, but not in any of the fatal cases.

In acute perforation of gastric or duodenal ulcer, the choice of procedure is limited to the consideration of drainage, the means of cleansing the peritoneal cavity, and the question whether or not primary gastro-enterostomy should be added to closure of the perforation.

The peritoneal cavity can best be cleansed by simple sponging and the use of suction apparatus; with the least possible traumatizing of peritoneal surfaces. Flushing with large quantities of salt solution is effective and safe if properly done, and is especially useful if there has been much escape of gastric contents through large perforations, especially of solid food particles. We flush much less frequently since the employment of suction apparatus has become a routine procedure.

Drainage may be safely omitted if the closure of the perforation is secure, and the cleansing of the peritoneum satisfactory. It should be employed if the friable inflamed tissue surrounding the perforation renders secure suture impossible; or if a localized abscess has formed. Drainage of pelvis or flanks is rarely necessary.

Primary gastro-enterostomy may be safely performed in many cases of acute perforation, especially of duodenal ulcer. It should not be performed if the condition of the patient or the extent of the peritonitis is such that the operative risk will be greatly increased.

Late roentgenoscopies have been made in twenty-eight cases of simple gastro-enterostomy, in all of which the pylorus was patent and not excluded, twenty-

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two cases showing excellent function of the stoma and good clinical result. Two show imperfect function with clinical improvement, but some persistence of gastric symptoms, three years and six months, and two years two months after operation. One fails to show an open stoma but the patient is free from clinical symptoms two years after operation. Another patient was well for about three years, but for the past eighteen months has had a return of symptoms and his stoma has apparently closed, four and a half years after operation.

Two patients are unimproved, one showing a functionating stoma, but also a penetrating unhealed ulcer (three years and nine months after operation); the other a closed or strictured stoma and probably an unhealed ulcer, one year after operation.

Of the six cases showing imperfect results, four were of acute perforating duodenal ulcers, and two of chronic duodenal ulcers.

Of the twenty-two cases showing a functionating gastro-enterostomy opening and a clinical cure, nineteen were of chronic duodenal ulcers; two of acute perforating duodenal ulcers, and one of acute perforating gastric ulcer. The time after operation at which the roentgenoscopies in these twenty-two cases were taken was as follows:

1 case .....5 years, 1 month
3 cases.....4 to 4½ years
5 cases.....3 to 4 years.
5 cases.....2-3 years
7 cases.....1-2 years.
1 case .....7 months

These findings would seem to justify the conclusion that in a good percentage of cases, a properly constructed gastro-enterostomy opening will continue to functionate in spite of a patent pylorus, and that a functionating stoma is usually accompanied by a clinical cure of ulcer symptoms. That closure or narrowing of the opening occurs in some cases is not disputed.

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GASTROJEJUNAL ULCERS

THEIR ROENTGENOLOGIC AND SURGICAL ASPECTS

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In any case in which gastro-enterostomy has been performed for symptoms due to a definite demonstrable lesion and has been followed by comfort for a varying period, and then by recurrence of certain or all the symptoms in greater or less degree, to determine the cause of the recurrence often occasions considerable perplexity. Without discussing the various possible causes, we wish to refer to the fact that the occasional disappointing result is due to the development of another ulcer in the vicinity of the gastro-enterostomy. These ulcers have been variously described as gastrojejunal and jejunal ulcers, and it is quite probable that cases of jejunal ulcer have been reported which were essentially gastrojejunal, and vice versa. Thus in reviewing the literature one is confronted with considerable difficulty in selecting cases of undoubted gastrojejunal ulcer.

Paterson[1] was one of the first to draw attention to these ulcers, and his comprehensive article refers to fifty-one other cases collected from the literature up to that time, fourteen of which were apparently true gastrojejunal ulcers. Other cases have been reported by W. J. Mayo,[2] Moynihan and Tatlow,[3] Mayo Rob-

1. Paterson, H. J.: Jejunal and Gastrojejunal Ulcer Following Gastrojejunostomy, Ann. Surg., 1909, l, 367.
2. Mayo, W. J.: Gastrojejunal Ulcers (Pseudojejunal Ulcers), Surg., Gynec. and Obst., 1910, x, 227.
3. Moynihan, B. G. A., and Tatlow, E. T.: A Case of Transgastric Excision for Gastrojejunal Ulcer, Lancet, London, 1914, i, 739.

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son[4] and Soresi.[5] From the records of our clinic we have been able to collect thirteen cases not hitherto reported. The salient facts of these are shown in Tables 1, 2 and 3.

A study of this group of thirteen cases does not enable us to state any symptoms or group of symptoms, or any physical findings which will be actually pathognomonic of these secondary ulcers. We believe, now, however, that in the patient who is quite relieved by gastro-enterostomy for a period, usually under a year, and then develops symptoms similar to those produced by the original lesion, such symptoms being persistent and unrelieved by any medication, that a second ulcer has occurred in the region of the anastomosis must be considered a strong possibility. It is most suggestive of a gastrojejunal ulcer if the patient complains of pain, of the same character, relationship to meals and severity, as in the previous trouble, though in a different situation, usually to the left of the midline and below the umbilicus.

Assistance from the Roentgen ray might reasonably be expected in the diagnosis of this condition, although, so far as we are able to learn, gastrojejunal ulcer has received little attention from the roentgenologic point of view. Mathieu and Savignac[6] note that in cases of jejunal ulcer perforating the colon, the Roentgen rays will show direct passage of bismuth into the colon. They state further that the colon may be narrowed by adhesions in the vicinity of the fistula, and the small intestine may be dilated in all or parts of its length. Those conditions are also susceptible of demonstration by roentgenoscopy. Their remarks seem to be based largely on some cases reported by Lion and Moreau,[7]

4. Robson, Mayo: Trans. Roy. Med. Chir. Soc., 1904, lxxxvii, 339.

5. Soresi, A. L.: Secondary Ulcers of the Stomach and Jejunum, Ann. Surg., 1915, lxi, 328.

6. Mathieu, A., and Savignac, R.: Étude sur les troubles intestinaux consécutifs à la gastroentérostomie, Arch. d. mal. de l'app. digest., 1913, vii, 541.

7. Lion, G., and Moreau, Ch.: La fistule jejunocolique par ulcère peptique du jejunum à la suite de la gastroénterostomie, Rev. de Chir., 1909, xxxix, 873.

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TABLE 1.—CLINICAL DATA PRIOR TO SECOND OPERATION

Case Number	Period Between First and Second Operations			Period Free From Symptoms	Onset of Symptoms	Relation of Pain to Food	Location of Pain	Relief of Pain		Vomiting	Character of Vomitus	Food Retention	Tumor
								Food	Soda				
	Yr.	Mo.	Day										
12869	4	10	11	3 years	Gradual, daily past 6 months	Irregular	Epig.	0	0	+	Bitter slime	0	0
69645		8	14	3 months	Gradual	?	?	0	+	0	0	+	0
76684		10	18	6 months complete	Sudden and severe	Increased by food	Left lower abdomen	0	0	+++	Sour, bitter	+	0
101545	16			?	Weekly for years, constant 1 year	?	Right iliac fossa	0	0	++	Retained food	+	+
81306		11	23	1 month	Gradual	0	Epig.	0	?	0	0	0	0
115553*	8	2	27	1 year	Gradual	Increased by solid food	Epig., lower left abd.	0	0	++	Food remnants	+++	At second operation +
96667	1	1		3 months	Gradual	After meals	Epig.	0	+	0	0	++	0
83614	1	5	5	2 months	Gradual	3 hours after meals	To right of and below umb.	+	0	0	0	0	+
98989		10	17	3 months	Gradual	Soon p. c.	Left of umb.	+	+	0	0	0	0
50276	3	8		1 year	Intermittent, spring and fall	10 to 12 p. m.	Epig.	+	+	+	Sour water	+	+
101624	1		21	?	Gradual	3 hours p. c.	?	Milk	0	0	0	0	0
131378		3	21	?	Gradual	3 hours p. c.	Epig.	+	..	+	?	0	0
51115		10	29	3 months	Gradual	2 to 4 hours p. c.	Left hypochond.	+	+	+	Sour	0	At second operation +

* Period between second and third operations, 5 months, 22 days.

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who collected five cases of jejunocolic fistula, including two of their own. One of these was examined with the Roentgen ray by Beclere.

Those of our cases of gastrojejunal ulcer which were examined by the Roentgen ray were all of a non-fistulous type. Admitting that the patients are too few in number for any hard-and-fast conclusions to be sustained, it is perhaps worth while to relate the Roentgen-ray findings and analyze them so far as possible.

Eleven of the patients were subjected to roentgenoscopy with the following results:

CASE 1 (12,869).—First operation, Aug. 1, 1908; posterior gastro-enterostomy for perforating duodenal ulcer. Roentgenoscopy, June 6, 1913, showed the gastro-enterostomy moderately patent. A filling defect was noted in the greater

TABLE 2.—ROENTGEN FINDINGS IN ELEVEN CASES OF GASTROJEJUNAL ULCER

Roentgen-Ray Findings	Case Number										
	50276	53614	51306	76934	98989	12900	69645	90667	115553	101624	151978
Deformity about stoma	+	..	..	+	+	+	+	+	+	+	..
Exaggerated peristalsis	+	..	+	+	..	..	..	+	+	+	..
Large stomach	+	..	+	+	Mod.	Aver.	+	+	..	..	..
Gastro-enterostomy not freely patent	+	..	..	+	..	Mod.	+	+	+	Mod.	..
Retention from six-hour meal	+	..	..	..	..	..	..	+	+	..	..
Lessened mobility of stomach	..	..	..	+	+	..	..	..	..	..	..
Dilatation of duodenum	+	..	..	..	..	..	..	..	..	..	..
Spasticity of stomach	..	+	..	..	..	..	..	..	..	..	..
Irregularity of jejunum	+	..	..	..	+	..	..	+	+	+	..

curvature, pars media, at the site of the stoma. There was no retention from the six-hour meal. The stomach was of average size and peristalsis was normal. No barium was seen passing pylorus at the time of the examination.

CASE 2 (69,645).—First operation, Oct. 10, 1912; posterior gastro-enterostomy for calloused duodenal ulcer. Roentgenoscopy, June 14, 1913, showed the gastro-enterostomy patent but not freely so. Some irregularity of the stoma was not well shown in the plate. The stomach was slightly larger

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TABLE 3.—FIRST AND SECOND OPERATIONS

Case Number	Age	Date First Opera.	First Operation	Findings First Operation	Date Second Oper.	Findings Second Operation	Probable Cause of Gastrojejunal Ulcer	Second Operation
12869	64	8/ 1/06	Post. gastro-enterostomy	Large perf. duod. ulcer	6/12/13	Large gastrojejun. ulcer, mostly gast.	?	Sep. of gastro-enteros.; mod. Finney
69645	55	10/10/12	Post. gastro-enterostomy	Calloused duod. ulcer...	6/24/13	Gastrojejun. ulcer	Knot of linen in region of ulcer	Excis. of ulcer; gastro-enter. enlarged
76684	41	12/ 5/12	Post. gastro-enterostomy	Perf. gastro-enterostomy	10/18/13	Gastrojejun. ulcer, ant. margin	Linen hanging in anastomosis	Excis. of ulcer; gastro-enter. enlarged
101545	46	1898	Ant. gastro-enterostomy; Murphy button	Pyloric obstruction.....	3/17/14	Large gastrojejun. ulcer	?	Ant. gastro-enteros.
81306	49	3/24/13	Post. gastro-enterostomy	Large post. duod. ulcer; contact ulcer	3/17/14	Gastrojejun. ulcer	Linen hanging in anastomosis	Pyl. div., gastro-enteros. enlarged
96667	51	12/12/13	Post. gastro-enterostomy	Large perf. duod. ulcer	10/12/14	Gastrojejun. ulcer	Linen hanging in anastomasis	Finney on jejunum
89614	48	5/14/13	Ant. gastro-enterostomy	Large perf. duod. ulcer	10/19/14	Gastrojejun. ulcer, indurated	?	Gastro-enteros. cut off. Resect. Pyl. Billroth No. 1
96989	30	2/10/14	Post. gastro-enterostomy	Obst. duod. ulcer.....	1/27/15	Jejun. ulcer, perf. post.	? Interrupted silk suture	Finney on duod. gastro-ent. cut off
50276	35	11/1911	Post. gastro-enterostomy elsewhere	Duod. ulcer	2/11/15	Small gastrojejun. ulcer, abscess posterior	?	Gastro-enteros. cut off; Finney pyloro.
101624	40	3/ 9/14	Post. gastro-enterostomy	Chron. perf. duod. ulcer	4/30/15	Large gastrojejun. ulcer	?	Excis. of ulcer; horseshoe plastic
131378	42	2/ 6/15	Post. gastro-enterostomy elsewhere	?	6/ 2/15	No evidence of gastric or duod. ulcer; gastro-enteros. high on fundus; gastrojejun. ulcer	Long loops silk sutures	Excised gastrojejunal ulcer; closure gastro-enteros.
51115	51	4/ 1/11	Post. gastro-enterostomy	Large contracting duod. ulcer	2/29/12	Large gastrojejun. ulcer, mostly gast.	?	Gastro-ent. cut off; Finney for stricture of healed duod. ulc.
115553*	44	6/29/06	Ant. gastro-enterostomy 2d oper., post. gastro-enterostomy; plastic for g-j ulcer	Duodenal ulcer; hour-glass stomach 2d oper., gastric ulcer; hour-glass stomach; gastrojejunal ulcer	3d Oper. 3/18/15	3d oper., large gastrojejun. ulcer, contracted opening	3d operation, linen sutures in ulcer	3d oper.; gastro-enteros. cut off, Finney

* Second operation 9/26/14.

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than the average gastro-enterostomized stomach; it was freely mobile, showing normal peristalsis. The duodenal bulb was irregular; the pylorus was free. There was no six-hour retention (Fig. 1).

CASE 3 (76,684).—First operation, Dec. 5, 1912; posterior gastro-enterostomy for perforating duodenal ulcer. Roentgenoscopy, Oct. 5, 1913, showed no retention from the six-hour meal. The stomach was larger than the average; its mobility was lessened. There was hyperperistalsis. The gastro-enterostomy was not freely patent. A marked filling defect was present on the greater curvature about the stoma. Barium in considerable quantity could be pressed through pylorus. The bulb was irregular.

CASE 4 (81,306).—First operation, March 24, 1913; posterior gastro-enterostomy for large posterior duodenal ulcer with contact ulcer. Roentgenoscopy, Feb. 5, 1914, showed the stomach quite large and mobile. Peristalsis was vigorous. There was no six-hour retention. The gastro-enterostomy was patent.

CASE 5 (115,553).—First operation in 1906; anterior gastro-enterostomy for duodenal ulcer and hour-glass stomach. First roentgenoscopy, Sept. 21, 1914, showed retention of one-fourth the six-hour meal and a large hour-glass stomach. A niche appeared on the lesser curvature. There was hyperperistalsis. The pylorus was very patent. The gastro-enterostomy was only moderately patent, with a slight irregularity about the stoma and narrowing of the efferent jejunum (Fig. 2).

A second operation was done Sept. 26, 1914, for gastric and gastrojejunal ulcer, with excision of the gastrojejunal ulcer; posterior gastro-enterostomy.

A second roentgenoscopy, March 11, 1915, showed retention of half the six-hour meal, the residue being between the stoma and the pylorus. Notwithstanding this retention, after filling the stomach the gastro-enterostomy seemed patent. Some irregularity was noted about the stoma. There was an hour-glass stomach. Hyperperistalsis and a niche on lesser curvature were observed (Fig. 3). A third operation was done March 18, 1915, for gastrojejunal ulcer.

CASE 6 (83,614).—First operation, May 14, 1913; anterior gastro-enterostomy for perforating duodenal ulcer. Roentgenoscopy, Oct. 13, 1914, showed the gastro-enterostomy functionating and marked spasticity of the stomach.

CASE 7 (98,939).—First operation, Feb. 10, 1914; posterior gastro-enterostomy for obstructing duodenal ulcer. Roentgenoscopy, Jan. 16, 1914, showed no retention; a stomach of moderate size with diminished mobility, and a patent gastro-enterostomy. A marked filling defect was noted on greater curvature about the stoma; also an irregularity of the first inch of the jejunum (Fig. 4).

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CASE 8 (50,276).—First operation elsewhere in November, 1911; posterior gastro-enterostomy for duodenal ulcer. Roentgenoscopy, Feb. 5, 1915, showed a large stomach with retention of one fourth of the meal after six hours. Peristalsis was active; gastro-enterostomy not freely patent; pylorus free. The plates show some irregularity about the stoma. The duodenum was dilated, the jejunum narrowed (Fig. 5).

CASE 9 (101,624).—First operation, March 9, 1914; posterior gastro-enterostomy for chronic perforating duodenal ulcer. Roentgenoscopy, April 27, 1915, showed no retention, the gastro-enterostomy very high on the stomach, and functionating moderately. The pylorus was quite free, the stomach of medium size and mobile with active peristalsis. There was a slight irregularity of the greater curvature about the stoma. The jejunum was narrowed (Fig. 6).

CASE 10 (96,667).—First operation, Dec. 12, 1913; posterior gastro-enterostomy for perforating duodenal ulcer. Roentgenoscopy, Dec. 6, 1913, showed retention of half the six-hour meal. There was hyperperistalsis. The gastro-enterostomy was not freely patent; the stoma was irregular, the jejunum narrowed, the stomach large, the duodenal bulb irregular. The pylorus was free (Fig. 7).

CASE 11 (131,378).—First operation, elsewhere, Feb. 6, 1915; posterior gastro-enterostomy for reasons not known. Roentgenoscopy, May 24, 1915, showed a small gastro-enterostomized stomach with gastro-enterostomy functionating. There was no six-hour retention.

For convenient comparison, the Roentgen findings are assembled in the accompanying tabulation:

Noteworthy is the fact that of the eleven patients examined ten showed abnormalities not customarily seen in the gastro-enterostomized stomach. After gastro-enterostomy the following conditions are found normally:

1. The opaque meal passes freely through the stoma. This is the rule, subject to occasional exceptions, even after the lapse of years.
2. No retention is present in the stomach from the six-hour meal.
3. The duodenum is not dilated.
4. The stomach is usually small.
5. Peristalsis is not overactive.

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6. The gastric contour in the vicinity of the stoma is not usually deformed, save for a slight dimpling at that point occasionally.

7. The efferent limb of the jejunum is neither narrowed nor markedly irregular in outline.

8. Extensive adhesions about the stoma simply as a result of operation are uncommon, and the stomach is at least moderately mobile.

9. The stomach is not deformed (unless by the original lesion or its resection) and has no tendency to hour-glass form or spasticity.

Summarizing the phenomena observed in this series, we note:

Deformity of contour about stoma	8 cases
Exaggerated peristalsis	6 cases
Large stomach	5 cases
Gastro-enterostomy not freely patent	5 cases
Retention from six-hour meal	3 cases
Lessened mobility of stomach	2 cases
Irregularity of jejunal contour near stoma	5 cases
Dilatation of duodenum	1 case
Spasticity of stomach	1 case

These signs may be classified in two groups: (*a*) those indicative of secondary pathology; (*b*) more direct signs pointing to the seat of pathology.

The first group includes retention from the six-hour meal, large size of the stomach, exaggerated peristalsis, lessened mobility of the stomach and spasticity. The first three mentioned, though sometimes resulting from other conditions, are fair indications of obstruction, and of strong significance in the gastro-enterostomized stomach with its presumptively free drainage. Lessened mobility, a feature which is not often accurately determinable, can be attributed to the production of an unusual amount of adhesions. Spasticity of the stomach, which was the sole abnormality noted in one case, simply pointed to an irritable focus, either within or without the stomach, producing spasm reflexly.

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The second group is of more importance in localizing the probable seat of trouble. This group comprises deformity of contour about the stoma, deficient patency of the stoma, local irregularity of the jejunal contour, and dilatation of the duodenum. Deformity about the stoma varied in degree as seen in this series but was sufficiently marked to attract attention in eight of the cases. In five instances the jejunum also showed definite irregularity near the stoma. Impaired functioning of the gastro-enterostomy with diminished discharge of the barium meal through it was found in half the cases examined. In one case considerable dilatation of the third portion of the duodenum was observed, suggestive of obstruction not far beyond.

The question arises: How far can the diagnosis of gastrojejunal ulcer be carried by the Roentgen ray? If this series be a sufficient basis for judgment, it would appear that in nearly all cases there are definite roentgenologic indications of an abnormal condition, and that in many instances there are more or less direct signs pointing to the location of the trouble. The most direct index of gastrojejunal ulcer noted in this series was marked deformity about the stoma. The nature of the ulcer rather precludes any probability of visualizing its crater as a niche such as is often seen in penetrating gastric ulcer; but in eight of the eleven cases examined an unwonted deformity and irregularity of and about the stoma indicated a pathologic process in that neighborhood. At present the Roentgen ray alone seems unable to go farther than this; however, a correlation of the Roentgen findings with the clinical data should aid materially in deciding whether a gastrojejunal ulcer is probably present or not.

The gross pathologic picture in our own cases and in those reported in the literature is more or less constant. The ulcers we have observed were of considerable size, from 1 to 3 cm. in diameter. They actually involved the anastomosis, with a tendency to

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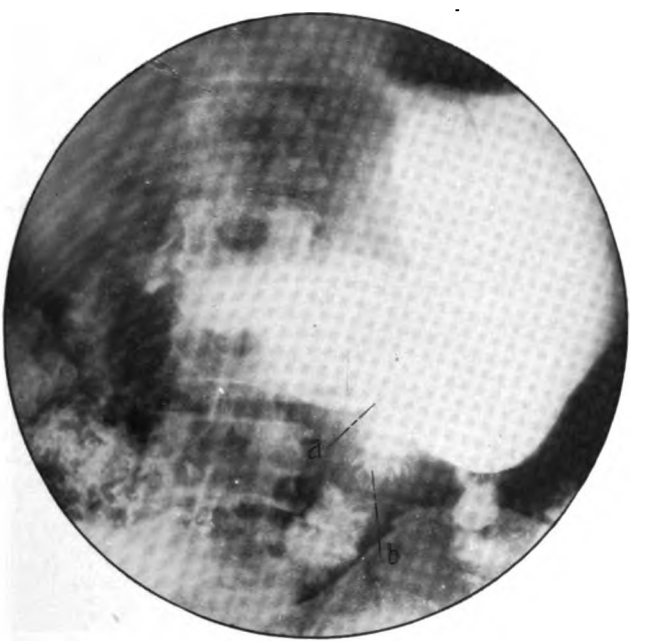

Fig. 1.—Case 69,645. Some irregularity of stoma at *a* with narrowing of jejunum, *b*.

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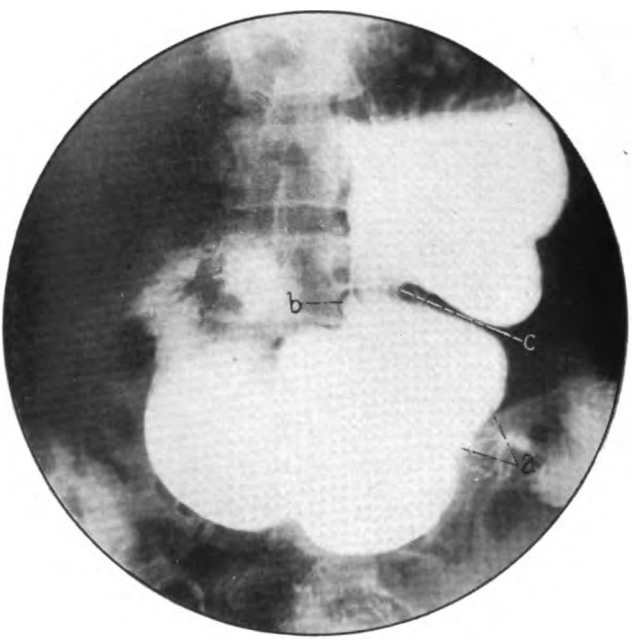

Fig. 2.—Case 115,553. (Prior to second operation.) Slight irregularity of stoma, *a*, which is not freely patent; niche of gastric ulcer on lesser curvature at *b*; hour-glass constriction at *c*.

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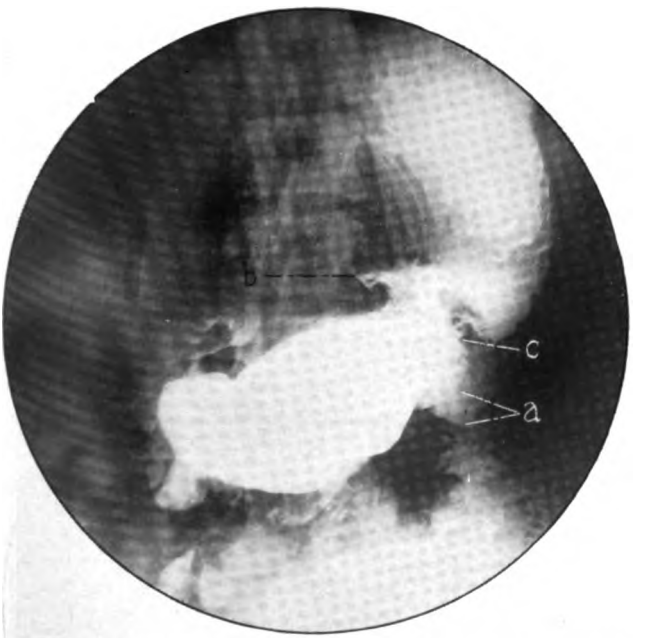

Fig. 3.—Case 115,553. (Prior to third operation.) Some irregularity of stoma and jejunum at *a*; niche of gastric ulcer on lesser curvature at *b*; hour-glass constriction at *c*.

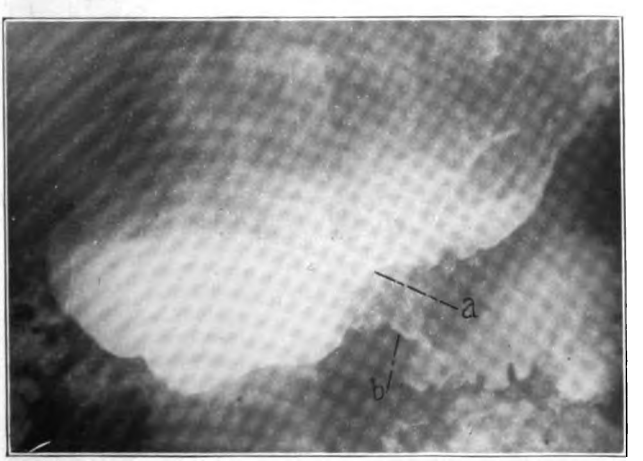

Fig. 4.—Case 98,939. Deformity about stoma at *a* and first inch of jejunum at *b*.

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Fig. 5.—Case 50,276. Large stomach. Irregularity about stoma at *a*; jejunum, *b*, not freely patent, as shown by the small amount of barium passing through it; duodenum, *c*, dilated.

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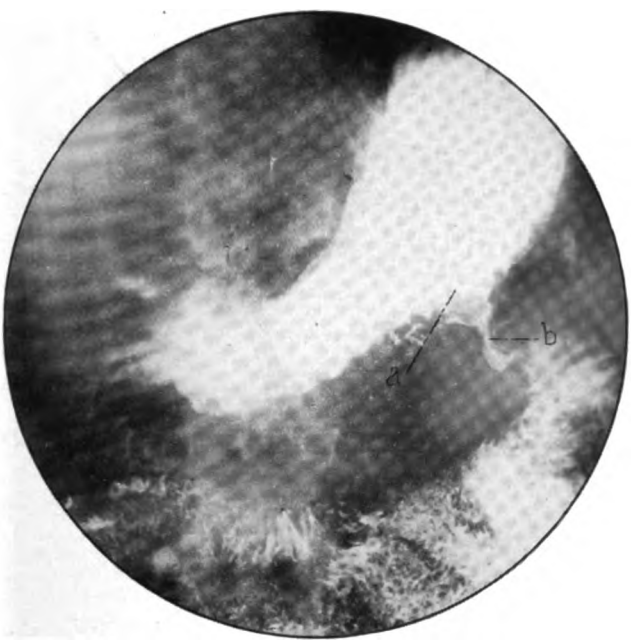

Fig. 6.—Case 101,624. Slight irregularity about stoma at *a*; narrowing of first inch of efferent jejunum, *b*.

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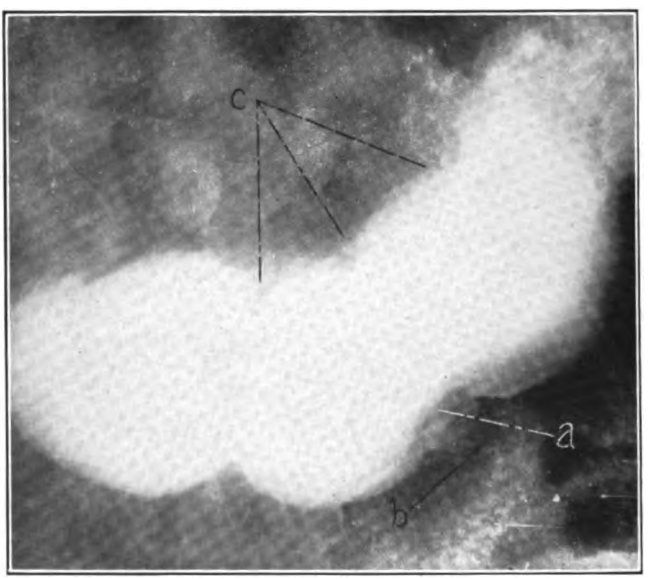

Fig. 7.—Case 96,667. Large stomach with deformity of stoma at *a;* narrowing of jejunum at *b;* note hyperperistalsis; peristaltic waves at *c.*

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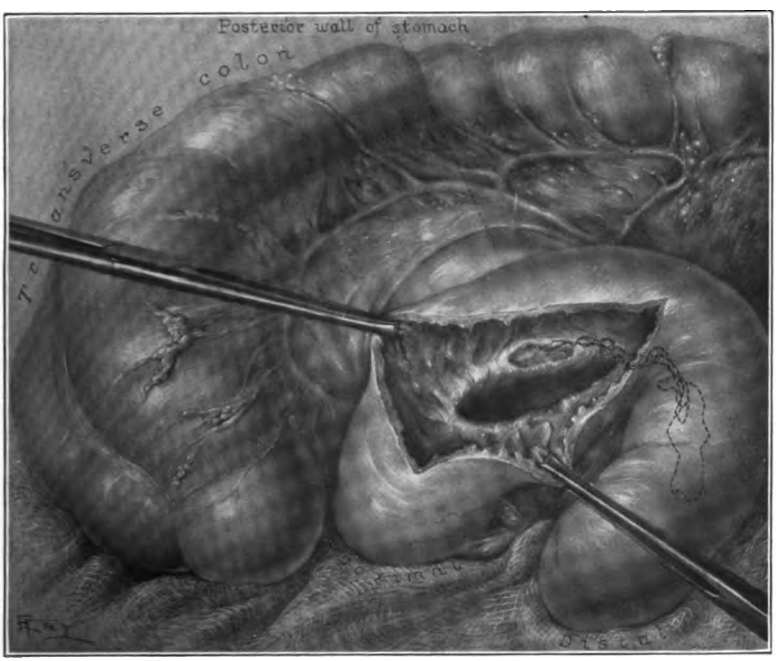

Fig. 8.—Stitch attached in gastrojejunal ulcer with end hanging in jejunum. Note the scar tissue behind the ulcer causing permanent thickening and adhesions.

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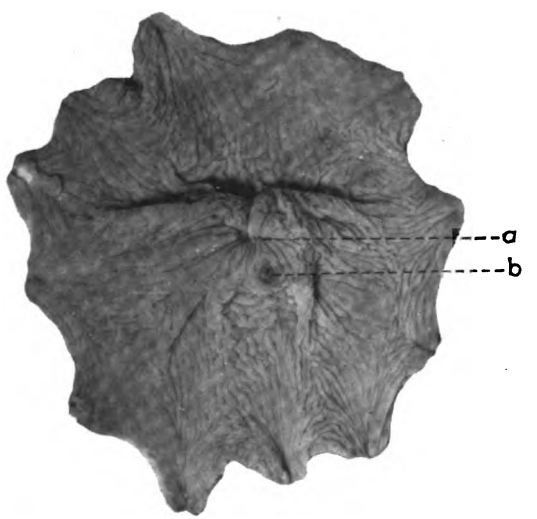

Fig. 9.—Small ulcer about 1 cm. in diameter around the suture; *a* locates the puckering of the healed mucosa; *b* is the ulcer, near the center of which is the suture.

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spread to greater extent on the jejunal than on the gastric side. Common to all and most striking is an associated marked induration of the entire line of anastomosis with firm adhesions to surrounding structures. This in three of the cases produced a palpable mass, especially prominent in the anterior gastro-enterostomy cases. Subacute perforation has been the rule, and in one case produced a fistula between the stomach and transverse colon.

Of greatest interest, in the findings, has been the discovery of strands of unabsorbed permanent suture material, in six of the thirteen cases (Figs. 8 and 9). This retained suture material may have constituted an important etiologic factor. The condition has been reported by other observers, W. J. Mayo in 1910 reporting retained linen in one of three cases of gastro-jejunal ulcers, Moynihan and Tatlow one in 1914; Soresi one in 1915. So far as can be determined, Berg[8] reported the first case of retained suture material following gastro-enterostomy. The patient had had an anterior gastrojejunostomy in 1895 for pyloric stenosis. In 1898 Berg reoperated by the Roux method, and the tissue removed showed a gastrojejunal ulcer in which was a coil of retained silk suture.

Regardless of whatever associated conditions may exist which predispose to the formation of these ulcers, we must accept the retained unabsorbable suture as of immediate importance. In the Mayo clinic as a means of prevention the technic for gastro-enterostomy has been modified to the extent that (1) a few interrupted sutures of fine silk are used as stay-sutures for the serosa, and (2) running sutures of chromic catgut are used for all other purposes. Strangulation of tissue by sutures is avoided in these cases, the mucosa is carefully coapted, accurate hemostasis is sought, trauma avoided, and a sufficiently large opening, suitably placed, is made.

8. Berg: Reported by E. Key, Den kirurgiska behandlingen af ulcus ventriculi, Nord. med. Ark., 1907, vii, No. 3, 1-95.

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There is no one surgical procedure which can be adopted as an operative measure in the treatment of all gastrojejunal ulcers. The difficulties which the individual case presents are usually dependent on marked induration and inflammatory changes surrounding the anastomosis. In the presence of this induration and infection, plastic operations on the anastomosis with removal of the ulcer are associated with corresponding technical difficulties. Nevertheless, this is the general indication and proves itself to be the method of choice in the majority of cases. In some it has been possible and advisable to excise the anastomosis, close the openings in the stomach and jejunum, and do a pyloroplasty, an operation, however, which also presents difficulties on account of the scar tissue which always exists in the neighborhood of the original ulcer.

Transgastric excision may be satisfactory in an occasional case, Moynihan reporting a good result from this method in one instance.

The general plan, therefore, in the light of our present information, is to expose the line of anastomosis by either a transgastric or transjejunal incision, search for retained suture and for the ulcer, remove both, the latter either by itself or with the entire anastomosis. If the anastomosis is constricted, and enlargement is possible and safe, such treatment is satisfactory; if, however, much induration and infection exist, excision of the anastomosis, closure of openings, and gastroduodenostomy are indicated.

It is to be expected that an operation which has developed such widespread and warranted popularity as gastro-enterostomy should occasionally be associated with results which are not satisfactory; yet the comparatively low percentage of patients who are not relieved of their symptoms by gastro-enterostomy should not deter us from investigating the causes of these few failures and attempting still further improvement in their diagnosis and prevention.

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THE SURGICAL ANATOMY OF CLEFT PALATE

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Favorable results in operations for the repair of cleft palate depend much less on the operator's skill and experience than on a clear understanding of certain essential facts of surgical anatomy. Of paramount importance is the conservation of the blood supply to the sutured palate. It is a comparatively easy matter to insure an adequate blood supply to the united margins if the dissection made in the preparation of the flaps is so carried out as to avoid injury to the large palatal vessels.

The blood supply of the hard palate is derived chiefly from the arteriae palatinae major and minor, which are the two divisions of the descending or posterior palatine artery, a branch of the internal maxillary. The larger vessel passes down the posterior palatine canal and emerges from the posterior palatine foramen which is internal to and behind the last molar tooth in the adult, and the last premolar in the infant. It runs forward in a groove on the inner side of the alveolar border of the hard palate to the anterior palatine canal, situated near the midline just behind the incisor teeth, where the terminal branch of the artery passes upward to anastomose with the nasopalatine artery. It sends branches to the mucous membrane of the hard palate and the palatine glands. The smaller division of the descending palatine goes to the soft palate.

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The blood of the soft palate comes largely from the smaller division of the posterior or descending palatine and also from the inferior or ascending palatine of the facial artery and ramifications of one division of the ascending pharyngeal, the smallest branch of the external carotid. The former divides near the levator palati and supplies the soft palate and the palatine glands. It anastomoses with the posterior palatine branch of the internal maxillary previously mentioned as the main arterial trunk to the palate. It is in the making of lateral incisions that this large trunk passing between the posterior and anterior palatine foramina, sending its largest branches medialward under the palatine mucosa, is extremely likely to be divided or even split for a considerable distance, for it is in the groove followed by the vessel that the knife blade fits and runs most easily.

After smart hemorrhage due to such an accident the flap on the corresponding side will usually be observed to be quite blanched and ischemic, a state which is clearly a precursor of nonunion.

Blakeway[1] calls attention to two important osculations of the most important palatal blood vessel, the descending posterior palatine. At its anterior extremity the terminal branch of the posterior or descending palatine turns upward into the anterior palatine canal and on the nasal septum anastomoses with the nasopalatine branch of the sphenopalatine artery. Should the descending palatine artery be divided, this anastomosis would not, as a rule, bring any large amount of blood to the hard palate owing to the small size of the nasopalatine artery. In the posterior canal, the posterior palatine artery gives off accessory palatine branches, which turn backward to anastomose with the branches of the ascending palatine from the facial. These posterior anastomosing branches are likewise small. Much confidence, therefore, should

1. Blakeway: Jour. Anat. and Physiol., July, 1914.

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not be placed in the ability of these anastomoses to nourish flaps. They are of some value, however, and should be spared, for example, the terminal branch of the descending palatine, at the anterior palatine foramen where it anastomoses with the nasopalatine, should not be carelessly torn in raising flaps from the hard palate.

It is obvious that in making lateral incisions for the elevation of flaps great care should be exercised, as stated by G. V. I. Brown, that such incisions be made as far lateralward as possible in order to avoid injury to the posterior palatine artery. Blakeway advises that the incision be directed outward against the alveolar process rather than upward against the palate, as otherwise the artery may suffer injury or its branches be divided. Likewise in making lateral incisions near the posterior border of the soft palate, for division of the levator palati muscle, it should be remembered that such an incision is quite likely to divide the ascending palatine artery, a vessel of considerable importance in the blood supply of the soft palate.

It may truthfully be said that much less depends on the method of suturing the flaps than on an adequate blood supply. It is most encouraging to observe after the completion of a cleft palate operation that the wound margins are red and not blanched. The free hemorrhage which accompanies the division of the large palatine arteries is nearly always easily controlled by sponge pressure in children, but this may not be the case in adults. In rare cases of severe hemorrhage from the palatine arteries it has been necessary to plug the palatine foramina with wooden pegs. I know of only one reported case of this kind. Doubtless, there have been many in which severe hemorrhage contributed in some measure to a fatality.

Avoidance of injury to the palatine vessels and the consequent hemostasis are obviously of value in keeping the field clear for accurate work. The swallowing

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of blood during a cleft palate operation often causes fever in an infant, this being either due to the direct absorption of the pyrogenous constituents of the blood or to the fermentation of other intestinal contents owing to the presence of blood.

All of the well-known evil effects of hemorrhage may be circumvented with considerable certainty, as Brophy says, by the simple expedient of avoiding lateral incisions, or if such incisions are absolutely necessary, making them after the flaps have been elevated and the lines of tension determined, so that only small incisions properly placed are required. It is then usually comparatively easy to relieve tension by placing the tiny incisions either lateralward or medialward to the descending palatine or at a safe distance in front of the ascending palatine. If in a case of very high arch of the hard palate with narrow cleft it should seem advisable to elevate the hard palatal flaps through a lateral incision, such a lateral incision should be just large enough to admit the raspatory or knife blade, and of course, in making it the course of the principal vessels cannot be ignored.

Two of the larger palatal nerves, the anterior palatine and the middle palatine nerve from Meckel's ganglion, correspond in their course and distribution to the two divisions of the descending palatine artery and would be endangered by any incision which would divide the vessels. These nerves supply the mucous membrane and glands of the palate but no muscles. The muscular nerve branches, that is, the posterior palatine from Meckel's ganglion and filaments from the otic ganglion and the pharyngeal plexus would of course be divided by a lateral incision which would divide the palatal muscles.

A further objection to the use of lateral incisions is found in the circumstance that if a flap attached only by its anterior and posterior extremities becomes strangulated as by encircling tape, or sloughs for any reason, a large amount of palatal tissue is irrevocably

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lost, and repair by a second operation is difficult or impossible. If lateral incisions are not used in the Langenbeck operation and there be failure of union, the second operation is beset with no unusual difficulties.

To elevate flaps by beginning at the borders of the cleft is, as a rule, not so difficult as to raise the flaps through a lateral incision. A convenient practice is to grasp the divided half of the uvula with tenaculum forceps and split the border of the cleft in the soft palate lengthwise but slightly on the nasal side of the margin. This split should be extended at once up to the posterior border of the hard palate. With scissors-spreading dissection, keeping in the gland tissue between the oral mucosa and the palatal muscles, all of the soft palatal tissue may be rendered movable except the aponeurotic attachment of the tensor palati at the border of the hard palate. The aponeurosis and the attached nasal mucosa must be divided with the curved scissors close to the border of the hard palate, the division extending outward and backward if necessary, almost to the posterior palatine foramen.

The anterior part of the soft palate next to the hard palate for a distance backward of 8 or 10 mm. contains practically no muscular fibers, being composed almost entirely of palatine aponeurosis, therefore this portion of the palate is quite fixed and must be detached in order that the corresponding side of the soft palate may be moved toward the median line. It is remarkable how this simple step enables one to close without lateral incisions and without tension, even the very widest defects. Tillmanns[2] emphasized the importance of this detachment of the soft palate from the edge of the palate bones, and James Berry considers this step one of the most important in the whole operation.

In thus dividing the palatine aponeurosis close to the hard palate margin, no muscle fibers are divided, no

2. Tillmanns: Lehrbuch der Chirurgie, Georg Thieme, Leipzig, 1897.

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blood vessels and no nerves of importance are severed and it becomes possible to draw medialward the soft palate in almost its entire thickness. The oral mucous membrane of the soft palate is of course continuous with the soft tissues covering the hard palate. Therefore, after detachment of the aponeurotic layer at the posterior border of the palate bones, it is comparatively easy to continue the separation of the oral mucous membrane of the soft palate forward over the hard palate by the use of an appropriate raspatory or periosteal elevator. One may begin by first elevating the mucoperiosteum from the hard palate and then dividing the aponeurotic attachment of the hard and soft palates by passing one scissors blade under the mucoperiosteum and the other in the nasopharynx, and by closing the scissors, cut the aponeurosis and the nasal mucosa. But since the raising of the mucoperiosteum from the hard palate is rather difficult in some cases, it seems to me that this may be facilitated by first splitting the edge of the soft palate near the edge of the palate bones, then dividing the aponeurosis and then continuing the loosening of the flap through the split soft palate over on the hard palate following a continuous plane of cleavage. I have never observed a case in which it was necessary to divide the tensor palati at the hamular process; however, if in any case it should be deemed necessary to make such tenotomy of the tensor palati at the hamular process, it would, I believe, be prudent to begin the tenotomy on the posterior border of the tendon just internal to the process, which may easily be felt behind and internal to the last molar tooth, cutting forward cautiously in order to avoid injury to the descending palatine artery at the posterior palatine foramen which is just in front of the hamular process.

The paring of the edges of the cleft after division of the palatal aponeurosis and the relaxation of the soft palatal tissues at each side may be accomplished by traction on one half of the divided uvula and

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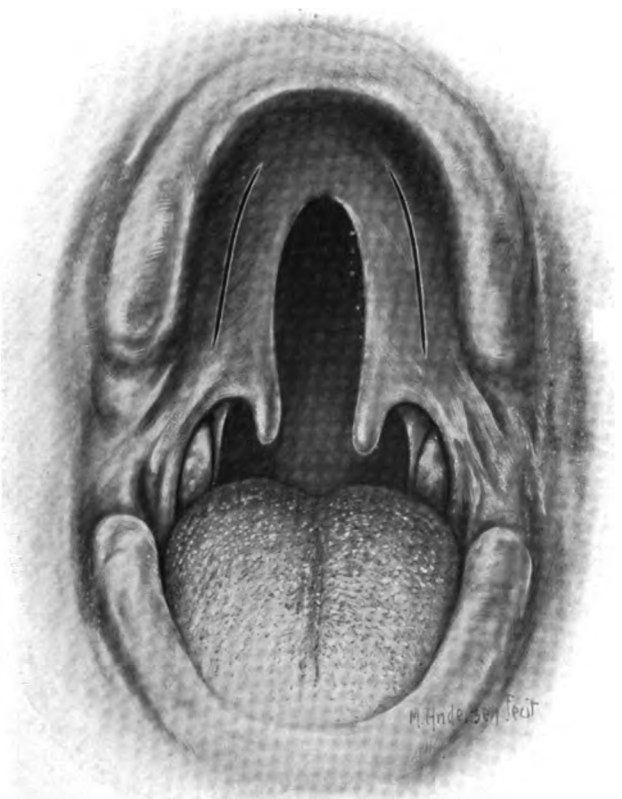

Fig. 1.—Lateral incisions erroneously placed mediad to the arteria palatina descendens

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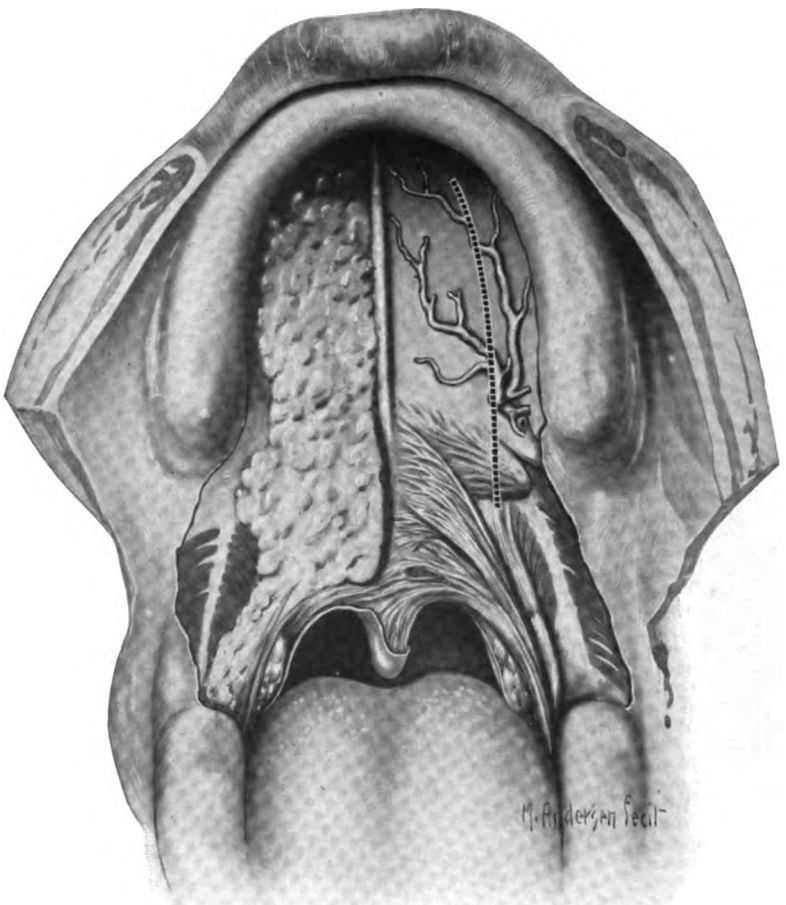

Fig. 2.—Severing of both divisions of arteria palatina descendens by lateral incisions too far mediad from the alveolar process.

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Fig. 3.—Palatal blood supply of full term fetus (after Blakeway).

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Fig. 4.—Proximity of tendon of musculus tensor palati (passing over rod at the right) to posterior palatine foramen immediately ventrad to it (after Blakeway). Cutting the tendon of the tensor palati at the hamular process endangers the arteria palatina descendens at the foramen.

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Fig. 5.—Division of aponeurosis and nasal mucosa at posterior border of hard palate injures no muscles. Arrow point indicates space between muscles of soft palate and palate bone.

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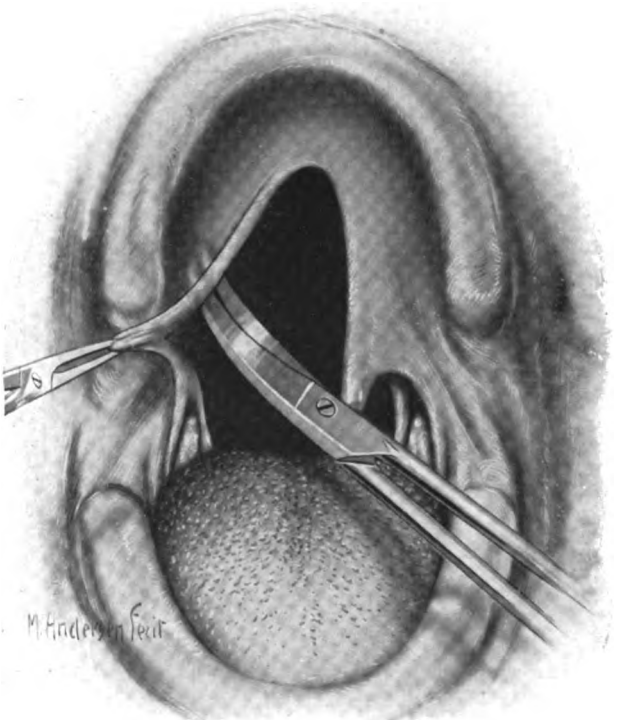

Fig. 6.—Splitting the edge of the soft palate on the oral side of the aponeurosis near the posterior border of the hard palate.

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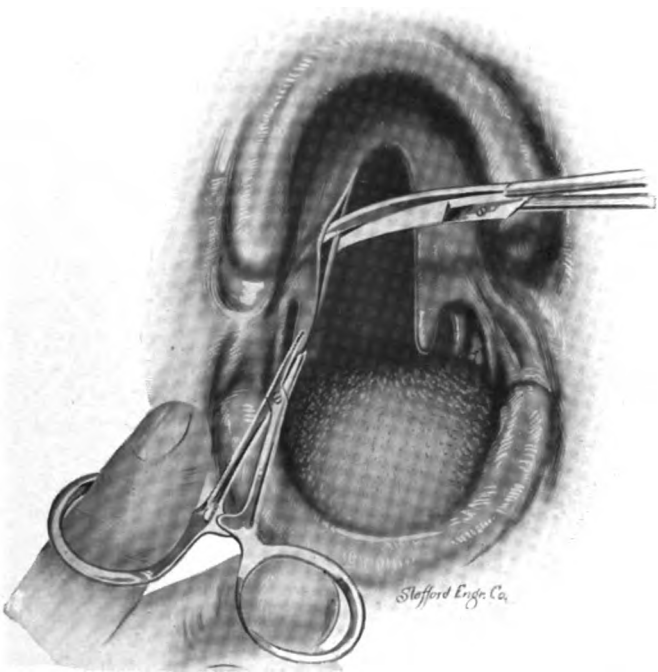

Fig. 7.—Division of aponeurosis and mucous membrane of nasal surface of soft palate at posterior border of palate bones—the most important step in mobilizing flaps.

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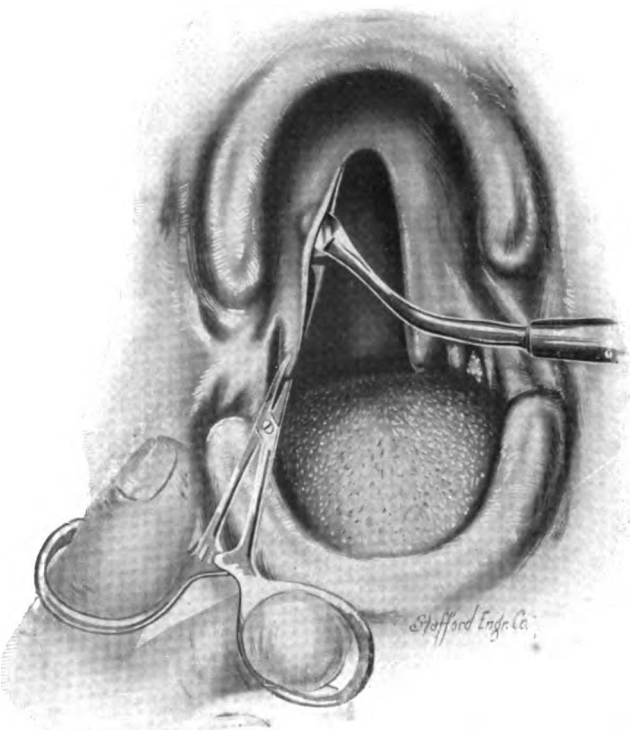

Fig. 8.—Elevating flap from hard palate by extending forward the split in soft palate.

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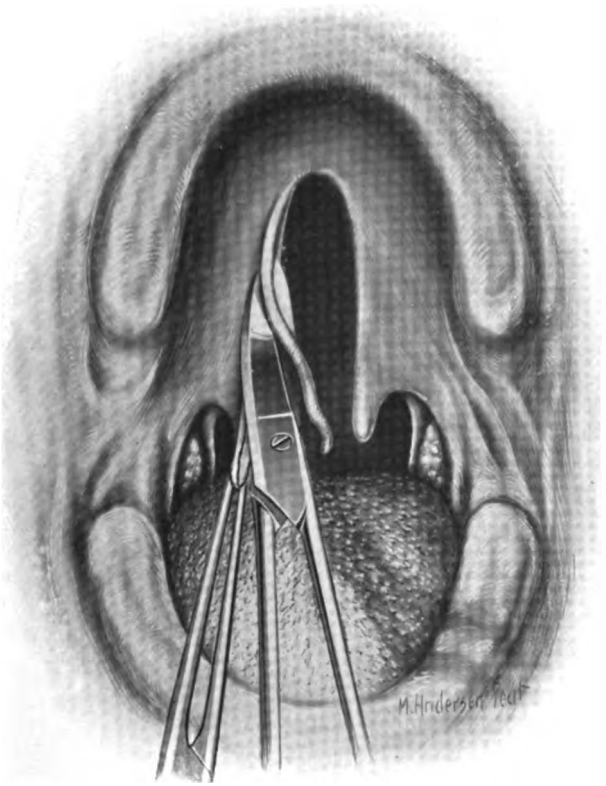

Fig. 9.—Paring edge of cleft with curved scissors. Grasping forceps at uvular half, render margin taut and roll it toward oral side.

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cutting off with curved scissors the rounded border of mucous membrane which might interfere with union. Drawing the half uvula taut with tenaculum forceps and rolling the relaxed border of the cleft toward the oral side, one may readily inspect its entire length, and with curved scissors cutting forward from the uvular end so freshen the mucosa which may tend to turn around to the nasal side, that no mucous membrane can interpose between the united margins.

The posterior part of the soft palate contains muscle fibers in abundance and is freely movable, being the portion on which most of the palatine muscles act. These include the palatoglossus, the palatopharyngeus, and the levator palati. The last muscle, according to Blakeway, must have nearly if not quite as much action as a tensor as a levator of the palate. Owing to the presence of these muscles, sutures at the posterior part of the soft palate must be secure enough to protect against the traction incident to swallowing. Here the coaptation sutures may with some advantage be reinforced by a relaxation suture along the free edge of the anterior palatine arch, that is, the posterior border of the soft palate. Such tension or immobilizing suture is introduced by passing a small curved needle bearing a long linen or hemp thread through the edge of the anterior palatine arch on one side near its base, that is, near the side of the tongue. The thread is drawn through to its middle and secured with a reef knot, leaving the tail of the suture long. At a distance of 3 or 4 mm. from the first or outermost knot, the needle is again passed through the edge of the arch; the tail of the suture is taken up and another reef knot is tied. This process is continued around the anterior palatine arch to its base on its opposite side, the suture crossing in front of the base of the uvula.

In closing narrow clefts of the soft palate, additional security is provided by uniting the two split margins of the cleft as suggested by Ochsner. The sutures

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approximating the nasal mucosa will probably include in their grasp more of muscle tissue than those on the oral side and are of value as tension sutures. If, in simple median suture, when the edges of the cleft of the soft palate are split the splitting is done slightly on the nasal side, one can gain a few millimeters of additional width for the flaps, and this is especially appreciated by those who use mattress sutures for the closure. The mattress sutures as suggested by Sherman of San Francisco for this purpose, bring together a broad surface for coaptation and prevent any inrolling or interposition of the mucous membrane. It is probably an error to use too many sutures of any kind. If the flaps are not under tension, no more than four or five are needed and the introduction of more may lacerate and strangulate the wound edges in a harmful way.

331 North Delaware Street.

ABSTRACT OF DISCUSSION

DR. HARRY M. SHERMAN, San Francisco: We grant at once the value of an adequate blood supply to insure satisfactory healing. Dr. Eastman's demonstration of the blood supply in the palate, and the method of preserving it, is admirable, but the thing which puzzles me is how I have succeeded in not having any sloughing after the operations which I have done, for I have never had sloughing of any kind due to interference with the circulation, and I have cut off the descending palatine artery in not a few cases on both sides. To be sure I try to keep outside of the artery in making the lateral incisions, but I lift up that whole flap well forward and back, and frequently then injure the vessel, and yet the ascending palatine coming up from the pharynx and anastomosing with the palatine branch in front has been ample for the nourishing of the flap. The interference with healing which I have encountered comes from infection of the wound or from tension. I can usually get primary healing in the mouth if there are no teeth. Therefore I try to do this operation on children so young that not even any of the deciduous teeth have appeared on the surface. The next thing is muscular action and the resultant tension on the sutures by the tensor palati muscles. It is impossible so to place the sutures as to paralyze those muscles during the healing of the part. Brophy's lead palates have never succeeded in doing this in my patients; but

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by preventing these children from doing any more swallowing than is necessary, I have minimized the work done by the palate and tongue. These children are fed by catheter through the nose, and if possible taught to submit to that before operation; but even in those instances in which there is no time for the training of the children before operation, it takes a very short time while the sutures are fresh and hold well to teach the children the method afterward. To further fortify the suture line, I like to put in releasing sutures running all the way across and taking up a little tension on either side well over toward the releasing incision, and in any case in which there are teeth and when I am certain there is infection, so that my stitches will become infected even if it does not lead to suppuration, I put around both of these flaps a broad piece of tape saturated with paraffin or bone wax, which will prevent the tape from sucking up the juices of the mouth. This I stitch at the back and in front, so it cannot slip, and I hold the parts together in spite of muscular action, and never have these infants had any catastrophe because of the interference with the blood supply.

Dr. Charles D. Lockwood, Pasadena, Calif.: I have had a great deal of experience in operations for cleft palate and agree with Dr. Sherman. I have experienced but one case out of fifty in which I have had sloughing. I believe the reason is because I use the blunt dissector—any dissector that will not lacerate or injure the vessels. I believe these vessels are lifted up. I dissect off a whole flap of mucoperiosteum from in front clear back by making a short incision and introducing a blunt dissector, lifting up the flap, and I do not injure the vessels. I wish to say that the pictures of Dr. Eastman are the best, and more nearly correspond with the actual conditions presented in these cases, than any I have heretofore seen. One important factor in the success of cleft palate operations is the time of operation. If you let these children go to 1 year or 14 or 16 months the flaps will drop down and approximate, and I believe the two things that cause sloughing are tension and improper approximation. I have had the best possible results with the lead plates advocated by Dr. Brophy, and, combined with horse hair and silver wire sutures, they are most important factors in good results. I have reoperated in a number of cases in which I have taken the smallest strip of mucoperiosteum, made flaps and obtained beautiful results. Where the blood supply comes from I do not know; either from the small blood supply that is attached to the undivided portion of the flap, or in the blood supply of the opposite side; but perfectly beautiful results in healthy children may be obtained by the use of flaps as recommended by Lane.

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DR. CHARLES H. PECK, New York: One or two points impressed me: Dr. Eastman mentioned the separation of the aponeurosis of the tensor palati from the hard palate and said that unless this is done it is impossible to get approximation. Division of the lateral pharyngeal plates of mucous membrane, or that which comes down from the eustachian tube can be snipped without dividing the muscle and teased apart so that after dividing the aponeurosis it will allow the drop of the flaps and approximation without tension. This is an extremely important point in these cases. I have always used a short lateral incision. Using blunt dissector work together with the short lateral incision, placing it far out against the alveolar border and trying to avoid the ascending palatine artery, in my experience never results in sloughing. It might, however, if such prolonged lateral incisions were used as Dr. Eastman used in the last illustration.

DR. GEORGE V. I. BROWN, Milwaukee, Wis.: Dr. Eastman has given us the right foundation for discussion of the subject of cleft palate. With his illustrations before us, the anatomic conditions met with in dealing with cleft palate are readily understood. But it must be remembered that his drawings represent practically normal circulatory conditions, whereas in complete cleft palate cases the fissures extend through both hard and soft palates and, if single, are usually deflected to the right or left of the median line and pass through the alveolar structures. In the so-called double cleft palates the premaxilla projects forward and is separated from the lateral segments of the upper jaw as the fissure bifurcates anteriorly. Therefore direct anastomosis of the vessels from the anterior and posterior palatine foramina is exceedingly doubtful. Fortunately for us, nature in her effort to support these parts appears to give an unusual supplementary blood supply; at least I like to think so when operating. The question as to the advisability of lateral incisions in palatal flap operations is after all a simple surgical problem. If there be sufficient tissue to permit accurate approximation when periosteal flaps are formed, then there will be no need of lateral incisions. When this cannot be accomplished without tension, lateral incisions must be made to give the necessary relief; otherwise the parts will slough or pull apart.

From my experience with many hundreds of these cases I have learned that the real test of the operative result usually comes some days after operation. These parts are wonderful in their ability to resist infection if treated with reasonable surgical care, but when the mucoperiosteal tissues have been lowered from the sloping sides of the palate walls and brought together in the central line there is necessarily a space between the bone and periosteal surfaces. If the

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flap borders unite promptly with sufficient strength and blood supply so that when the parts draw back again to be reunited to the denuded bone surfaces the tissue granulation through the central line can keep pace with it, then the result will be complete union; otherwise a partial or complete failure will result.

DR. JOSEPH RILUS EASTMAN, Indianapolis: We would benefit greatly if all operators would give us complete, truthful reports about cleft palate end-results. It is amazing how difficult it is to get reliable statistics as to the final results, relating especially to phonation. It has leaked out here that several gentlemen have done the Langenbeck operation in the same case several times. It may be stated as a fact that the most skilful palate surgeons in the world not infrequently do more than one operation on a single cleft palate. Many surgeons do them over and over again without satisfactory results. Technic in this field may, I think, still be studied with profit.

The difference between omitting lateral incisions and making them is the difference between pleasure and pain. If you make them liberally and cut muscles and blood vessels it will be your painful experience to see, in not a few instances, failure of union because of inadequate blood supply. There may be no infection, still the ischemic wound margins fall apart. If you omit the lateral incision it will be your pleasure as a rule to observe after you have finished the operation a mucosa red and viable. However, because it was said that lateral incisions are to be avoided when possible or to be made as small as possible, that does not imply that they are to be entirely abandoned. One does not often need to make a big incision. A small incision made in a line of tension is often of great service; then, too, a large lateral flap may be raised through an incision only big enough to admit the narrow knife blade, the separation being accomplished by moving the blade pendulum-like, the point traversing a wide arc. As to the possibility of bringing the lateral flaps together, Mr. James Berry has said he would be grateful to any one who would bring him a case of cleft palate that could not be so corrected. It is well to recall our elementary principles of histology and physiology. Do not we want all the blood available in any plastic flap anywhere? Before I began to avoid long lateral incisions and injury to arteries I felt very much discouraged about my cleft palate surgery, but since I have learned to conserve the blood supply, my results are improved to such a degree that I can undertake such work with pleasure and confidence.

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ILEOCOLOSTOMY AND COLECTOMY FOR ARTHRITIS DEFORMANS

REA SMITH, M.D.
LOS ANGELES

The limited number of successful results obtained in the treatment of arthritis deformans by less radical measures than an intestinal operation has prompted me to report this small series of cases. For the last two years I have been studying from the point of view of Sir Arbuthnot Lane, all the cases of chronic arthritis which have occurred in my practice, and have followed Lane's method of treatment in a number of them.

Briefly stated, Lane's theory is that intestinal stasis, with a resulting toxemia, lowers the general resistance and makes possible the microbic invasions which cause chronic arthritis, and that the relief from toxic absorption attendant on perfect intestinal drainage is followed by increased resistance on the part of the patient, with a disappearance of the infection.

I have had the opportunity of examining with the fluoroscope eighteen cases of arthritis deformans and in each case have found a marked ileal stasis, usually associated with a dilated, prolapsed cecum and evidence of colon stasis as well.

While Lane's theory regarding the formation and absorption of toxins from the small intestine is undoubtedly right, Rosenow's work on the transmutation of streptococci has suggested to me the possibility that we might also find the portal of entrance of the invading organism in the intestine, and that the head infections were merely local evidences of the same general infection that was present in the joints, especially as the clearing up of these infections, by remov-

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ing tonsils and pulling teeth, has not been attended with the striking results it promised when first suggested.

The terminal ileum is the natural habitat of the *Streptococcus viridans*[1] and it seems more logical to look for its portal of entrance into the blood stream through the wall of an intestine, congested, edematous and continually filled with culture mediums, than to go out of our way to find some obscure and less obvious source of infection. We have made bacteriologic examinations of the walls of the ileum and colon in two cases, and of the ileum alone in a third. The mucous membrane was stripped off, the wall macerated and cultures made. In the first case we obtained a growth of *Streptococcus viridans* from both ileum and colon. In the ileum the *Streptococcus viridans* was the predominating organism, while in the colon the *viridans* colonies were more scattered. In the other cases we grew a hemolyzing streptococcus in each instance. Cultures from the walls of three other colons, removed for other causes than arthritis, showed no *viridans;* two of them showing a hemolyzing streptococcus.

Before presenting this report I wish to say that no operations have been performed in borderline cases. These patients have been through all the modern lines of treatment, by medicines, vaccines, baths and electricity, as well as removal of tonsils and, in some instances, pulling of teeth, with no more than transient good effect, and were in each instance willing to accept any operative form of treatment, no matter how serious, which held out even a chance of staying the disease and lessening the pain.

In the typical case, following ileocolostomy the pain in the joints disappeared in less than forty-eight hours, and the movement of the joints returned up to the point of limitation by contracted muscles. The crepi-

1. Schottmüller: Handbuch pathogenischer Microorganismen, iv, 467.

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tations disappeared day by day until, at the end of three or four weeks, old dry creaking joints moved as freely and quietly as if they had never been infected. This condition, which was so encouraging to both patient and surgeon, was followed by a recurrence of the joint symptoms in more than half the cases, as I will show in my detailed report. In the recurrent cases the removal of the colon down to the point of anastomosis was again followed by the disappearance of all joint symptoms, and while some of these patients have had joint pains, but one of them has returned to the former condition of helplessness.

I have operated in fourteen cases. In two I did ileocolostomy and colectomy at one operation; both patients made good recoveries from a surgical point of view and were markedly benefited from the point of view of their disease. Of the remaining twelve patients on whom short-circuiting operations were done, one died on the fifth day of uremic convulsions, having passed no urine for seventy-two hours. This, the only mortality in the series, should be attributed to bad judgment in selecting the case for operation rather than to the surgery itself. The patient had nephritis, was bedridden with arthritis deformans, and was operated on as a last resort, both patient and surgeon realizing the chances that were being taken. Of the remaining eleven patients on whom short-circuit operations were done, five made good recoveries, the joint symptoms disappeared and three of the patients were able to resume their occupations with little or no pain and much less disability than it would seem possible from their previous condition.

One, a girl of 26, was operated on at the County Hospital at the meeting of the Southern California Medical Society in November, 1914. This patient, who had had arthritis since she was 4 years old, and was a helpless cripple, unable to move from her wheel chair, is now earning her living as a child's nurse.

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The remaining six patients all made an early improvement, which was only temporary, and returned to their former conditions within a few weeks. Four of these patients have since had a secondary colectomy. One case has turned out a failure, the patient being no better now after six months than she was before the original short circuit, with the single exception that an obstinate constipation has been relieved. Recent roentgenograms of this patient show a marked eighteen-hour stasis still existing in the ileum, evidently from a narrow anastomosis due to adhesions, as the opening was patulous at the time of the secondary colectomy. Of the remaining three patients on whom colectomy was performed, two were bedridden, and the third was on crutches at the time of the secondary operation. All are now greatly improved; the disease has been arrested, and in each case the patient is able to walk without assistance. Of the remaining two patients with short-circuits, who have relapsed to their former condition, I can make no further report until they have their colons removed. I shall include them, however, in the list of cases receiving no benefit, hoping that a supplementary report may place them on the other side.

I have then to report fourteen patients with twelve ileocolostomies, two ileocolostomies with accompanying colectomy and four secondary colectomies, with one death, a mortality of 7.15 per cent. The disease has been arrested, and the patients have been cured or greatly benefited in ten of the remaining thirteen, making 76 per cent., or ten of the series of fourteen, making 71 per cent. In no case in this series have there been any of the ill effects of the so-called bad mechanics of which we hear so much in all discussions of Lane's work. There has been no case of persistent diarrhea, and no persistent backing up into the blind pocket of the colon causing impaction, and no development of a giant ileum.

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I am convinced that by a careful analysis of the intestinal condition, as shown by repeated roentgenoscopy before operation, it is possible to avoid impaction of the colon after short circuit. The success of short circuit depends on proper understanding of the mechanics and physiology involved and careful selection of cases. If any obstruction exists in the colon between the cecum and the point of intended anastomosis this obstruction must be relieved or the colon removed. Impaction of the colon depends on interference with normal peristalsis and will not develop in the side-tracked segment if it is freely open. The fluid contents of the ileum easily pass back to the cecum through a narrow colon, where the fluid is absorbed and the residue is unable to return. The short circuit of Lane is designed to relieve a partially obstructed ileum, and is not to be used to correct an obstruction in the large bowel. If it is so employed, it will surely be followed by a bad mechanical result. It has been repeatedly shown by various men that any fluid thrown into the terminal segment of the large bowel will be carried immediately to the cecum by reverse peristaltic waves. Here the fluid is absorbed and the presence of the residue excites the normal peristaltic waves which carry it back to the lower segment or container. This is precisely what happens after short circuit, and there will be no difficulties with either diarrhea or impaction of the blind pocket so long as the colon is unobstructed. I am satisfied that the ileal contents in all *successful* short-circuit cases back up into the blind pocket, and the only ones that get into trouble are those with a partially obstructed colon from which the solid residue cannot return.

CONCLUSIONS

1. The portal of entrance of the streptococcus, in all the cases of chronic arthritis that I have had an opportunity of studying, is the ileocecal coil; and the stasis in the terminal ileum is the predisposing cause.

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2. Drainage of the ileum will cure this infection in a large proportion of cases. The colon will have to be removed as well, if the cecal walls have become infected.

3. The operation as described by Lane is a proper surgical procedure, not necessarily attended with an undue percentage of bad postoperative sequelae, if done in properly selected cases.

4. The operative mortality is not prohibitive.

5. That ileocolostomy or colectomy will effect a cure in a higher percentage of cases of arthritis deformans than any other method of treatment heretofore suggested.

Brockman Building.

ABSTRACT OF DISCUSSION

DR. J. F. PERCY, Galesburg, Ill.: There are two things in this paper that should be noted. First, that infections of the teeth and tonsils may be intestinal in origin and that these easily recognized local conditions may only be a part of a general infection of which arthritis deformans is the most serious expression. Second, the author tells us that he has had no persistent backing up into the blind pocket of the colon causing impaction and no development of a giant ileum. This statement is important because the knowledge of this sequel to an ileocolostomy has made many surgeons hesitate to follow Mr. Lane in his advocacy of this operation. The author also tells us that in order to avoid this impaction there must be no obstruction between the cecum and the point of intended anastomosis; that if there is, the colon must be removed. This point, if true, and we have no reason to doubt it, is most important. In other words, if normal peristalsis is not interfered with, the colon will not become impacted. This simply means that in doing this operation we should see that not only a previously existing obstruction to peristalsis is not left uncorrected, but that our method of operating does not interfere with the physiology which permits the liquid contents of the bowel to pass into the colon in order to be deprived of its water, and when so altered to pass out again through an unobstructed channel. Lane's short circuit, therefore, will relieve a partially obstructed ileum but has no place in an attempt to correct an obstruction of the large bowel.

While visiting Rollier's Sanatorium in Leysin, Switzerland, two years ago, I was greatly impressed with his end-results

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in what we have heretofore considered utterly hopeless tuberculous joints. His exposure of these joints and of the whole body to sunlight and the open air cleared them up even when involved in secondary infections, and with a movable joint, in a most astonishing way. If this type of tuberculous joint infection will yield to appropriate treatment and become practically normal in function, I am ready to believe that the essentially ankylosed joints of arthritis deformans can again be made movable as is most strikingly shown by the patient exhibited here. This is a subject that will not down. We are all convinced that there is something to it. What we need are papers such as this one and others on the program of this meeting to clear up what is obscure in meeting the indications, not only of technic, but of physiology as well.

DR. M. CASPER, Louisville, Ky.: Did any of these patients have Lane kink or adhesions?

DR. REA SMITH, Los Angeles: Almost all of these patients were operated on before and had marked adhesions and distinct bands. The patient whom you have just seen had three loops of ileum bound down to the stump of the uterus, which had been removed a number of years before. I have one patient now, being treated with a support, who has as marked a stasis as you saw on the screen, but in whom the intestines are all movable; she has had the same results as though operated on, because she is now getting thorough drainage of the ileum.

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FASCIAL TUBULIZATION IN THE REPAIR OF NERVE DEFECTS*

EDWIN G. KIRK, M.D.
AND
DEAN LEWIS, M.D.
CHICAGO

It is difficult to determine the value of the different methods which have been employed to promote reconstruction of defects in nerves caused by accident, or to restore their continuity after resection because of painful scars, malignant growth, etc. The clinical reports are often meager and in many instances the patients have not been traced long enough to permit of any definite conclusions concerning the ultimate result. The results frequently admit of more than one interpretation. In many of the cases reported sensation and motion have not been carefully tested and often, in estimating final results, account is not taken of the fact that sensation, and even motion, may be present, at least to some extent, in the area supplied by the nerve which has been divided or resected.

Vanlair[1] (1882) first suggested that defects in nerves might be repaired, if a pathway were provided, along which the axis cylinders developing from the proximal stump might pass to invade the distal part of the nerve. A number of different materials, silk protective, fresh and hardened blood vessels of the same or different species, epidermis, magnesium and hardened gelatin tubes have been used in clinical and

* From the Department of Experimental Surgery, Morris Institute of Medical Research of Michael Reese Hospital.

1. Vanlair: De la néurotisation du cartilage osseux dans la suture tubulaire des nerfs, Arch. de Physiol., 1882.

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experimental work for this purpose. That none of these is highly satisfactory is indicated by the few clinical cases in which any one has been used and by the lack of uniformity in the results obtained.

Huber,[2] after careful experimental work, came to the following conclusions concerning the bridging of nerve defects:

1. It is possible to restore functional activity to the peripheral part of a divided nerve with loss of substance, if the resected ends are united by a segment taken from some other nerve trunk, by a catgut bridge, bone drain or tubular suture.

2. The most favorable results are obtained after implantation of nerve segment, the two ends of which have been sutured with one or several catgut sutures to the resected ends of the injured nerve.

3. Regeneration of the peripheral end is the result of the outgrowth of new axis cylinders from the undegenerated axis cylinders of the proximal stump, the budding axis cylinders following the paths of least resistance to reach the peripheral part of the resected nerve.

4. That degenerated fibers of an implanted nerve segment offer much more favorable mechanical conditions to the downgrowing axis cylinders than does the loose connective tissue which supplants the catgut sutures, when this type of bridging is attempted or the bone drain, is shown by the fact that the new nerve fibers have a much straighter course and more regular arrangement in the tissue uniting the resected ends than in the case in which the latter procedures are employed.

Kilvington[3] (1908), in reviewing the literature, found that the results of homoplastic nerve transplantation were uncertain. Sherren[4] cites one success in six

2. Huber, G. C.: A Study of the Operative Treatment for Loss of Nerve Substance in Peripheral Nerves, Jour. Morphol., 1895, xi, 630.
3. Kilvington: Brit. Med. Jour., 1908, p. 1414.
4. Sherren: Edinburgh Med. Jour., September, 1906.

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cases and collected twenty cases, six of which could be regarded as successful. He found record of but two cases of autoplastic nerve transplantation, one of which was successful. Kilvington experimented with free nerve transplantation and obtained poor results with heterotransplants; fair with hemotransplants, and good with autotransplants. With autotransplants he obtained what he considered functionally perfect results in five out of seven cases. The gross appearance of the nerve when removed was good and there were few adhesions. In one case he bridged a gap of 2 inches in the sciatic nerve. After one hundred days there was complete recovery of sensation and motion. The value of Kilvington's work is somewhat impaired by the criteria adopted by him regarding successful results, namely, the gross appearance of the regenerated segment, the functional recovery of the muscles and the reaction to electrical stimulation. The inadequacy of these criteria will be discussed later. Microscopic examinations were made of but four cases. Kilvington believed that the axons of the free transplant survived and assumed function. This position is untenable in the light of recent and past neurologic research, as it has been conclusively demonstrated that the axis cylinders degenerate in a free transplant and that the sheaths merely form conduits through which the newly formed axis cylinders can pass.

The best results in transplantation are obtained by tissue removed from the same individual. Nerves and blood vessels frequently cannot be sacrificed to bridge defects in nerves. A tube formed of fascia, providing it did not collapse and undergo secondary cicatricial contraction would be ideal, for the supply is unlimited; a tube of any size can be fashioned to be applied to the nerve in question; and fascia when appropriate conditions are provided contracts no adhesions and remains viable.

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TECHNIC OF OPERATION

After the sciatic nerve of the dog is exposed and the section removed, a piece of fascia lata of approximately the required size is removed. No muscle fiber is included. The smooth shiny surface of the fascia lying next to the muscle becomes the inner side of the tube. Some fat usually remains attached to the outer surface. In some cases the loose areolar tissue covering the fascia on the muscle side was scraped off. This seemed to favor contraction and was discontinued in the later experiments. The method of formation and fixation of the tube is indicated in Figure 1. In some of the experiments the nerve was exposed, cut, and the ends crushed. After two weeks or more the nerve was again exposed, the ends recovered and freshened, after which the fascial tube was applied.

Several points are deemed to be of especial importance in the technic. All trauma to nerve, fascia and surrounding tissue must be avoided. A sharp dissection should be made and hemostasis should be as perfect as possible. The suture must be applied loosely so as not to strangle any part of the nerve. Hemorrhage from the ends of the nerve must be controlled, for blood within the tube will prevent the axis cylinders passing downward. The tubes in cases in which hemorrhage occurred into them were almost occluded by scar tissue. To prevent blood passing from the surrounding tissues into the tube both end-sutures are so tied as to approximate the fascia snugly to the nerve. The tube should have a large lumen to guard against secondary contraction if this occurs. The lumen should be twice the size of the nerve end.

We have performed the operation of tubulization on the sciatic nerve of forty dogs. Ten of these are still living at periods varying from seven days to nineteen weeks after the operation. Two were discarded because of local infection and death from pneumonia. Seven specimens have not yet been studied histologi-

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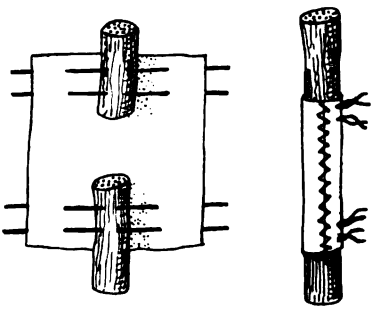

Fig. 1.—Diagram showing method of construction of fascial tube.

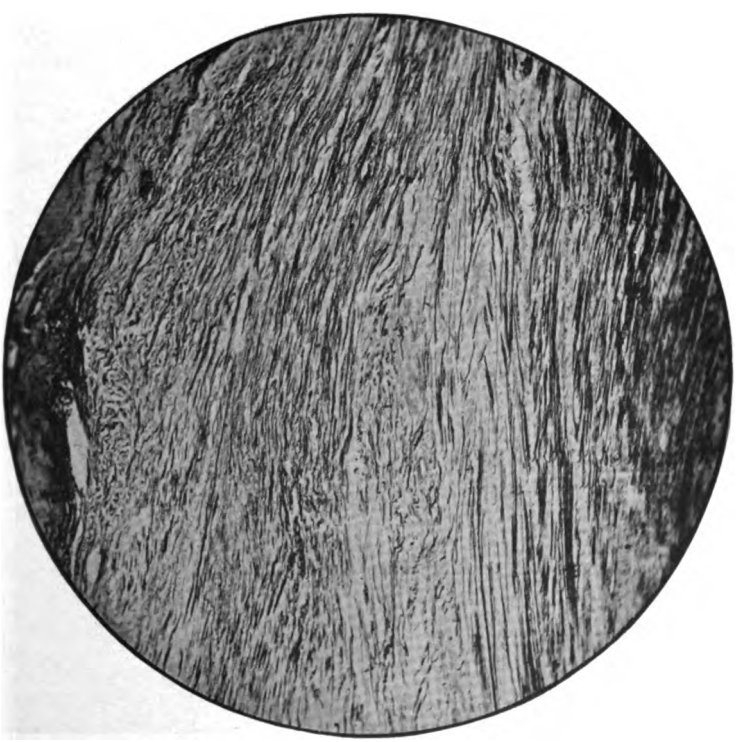

Fig. 2.—Section of regenerated segment (within fascial tube) 1.5 cm. below level of plane of proximal section, four weeks after operation (from photomicrograph × 60).

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Fig. 3.—Distal segment four weeks after operation showing invasion of regenerated axis cylinders, some of which are arranged in bundles (× 130).

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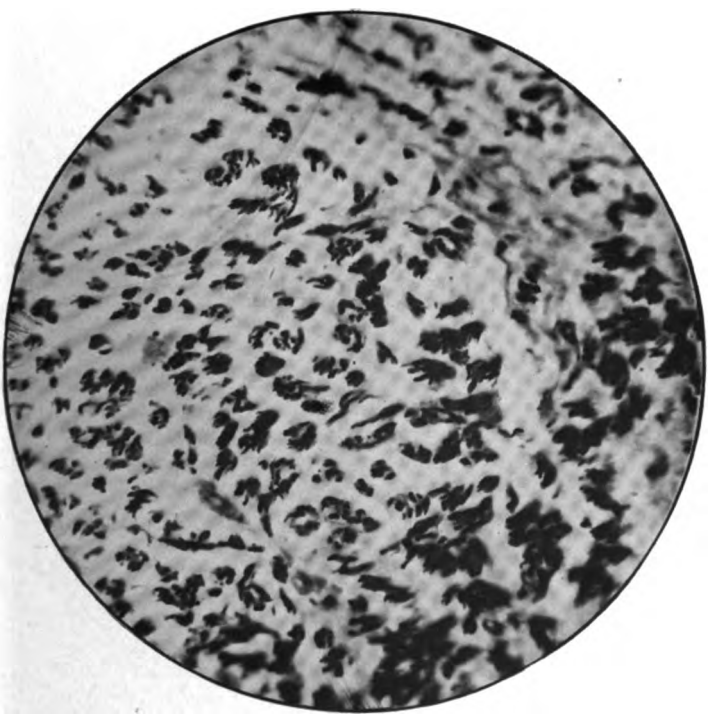

Fig. 4.—Proximal segment just above level of proximal plane of section six weeks after operation (× 325). Note enormous increase of nonmedullated axis cylinders. A few medullated fibers are seen surrounded by several nonmedullated axis cylinders (newly formed), situated under and applied to the neurilemma sheath.

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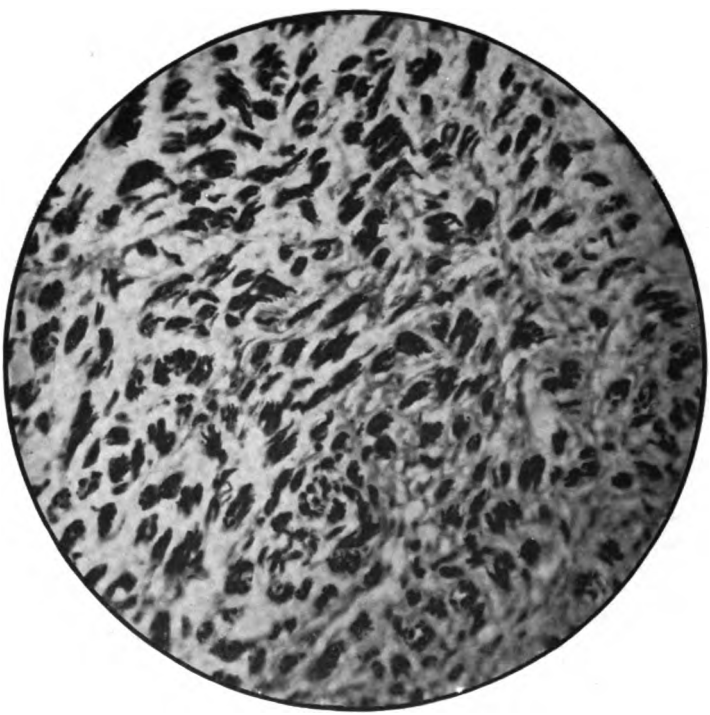

Fig. 5.—Regenerated segment six weeks after operation (×325). Great numbers of nonmedullated axis cylinders arranged in orderly bundles are shown.

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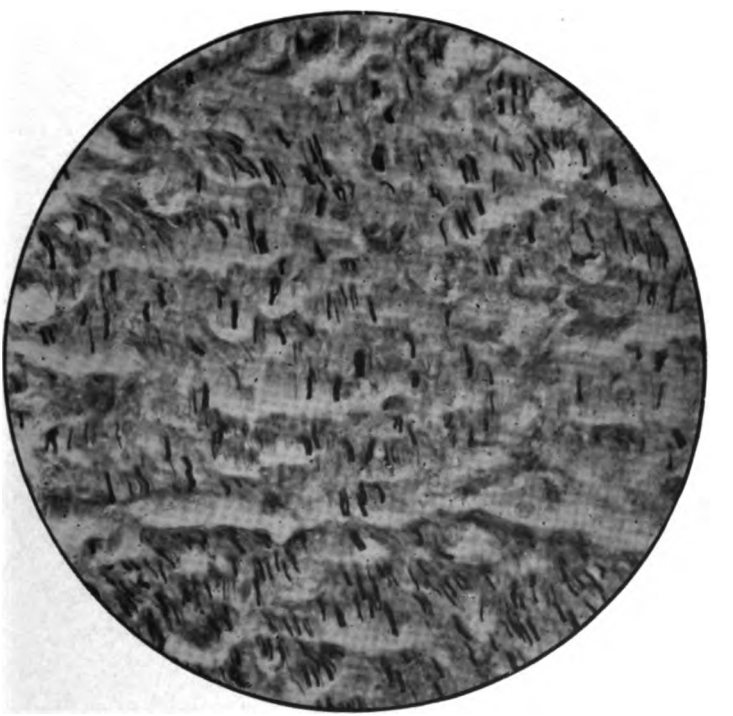

Fig. 6.—Distal segment 11 mm. below level of plane of distal section six weeks after operation (× 200). Shows regenerated axis cylinders arranged in bundles, also remnants of degenerating medullated fibers.

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Fig. 7.—Distal segment seven weeks after operation (× 70).

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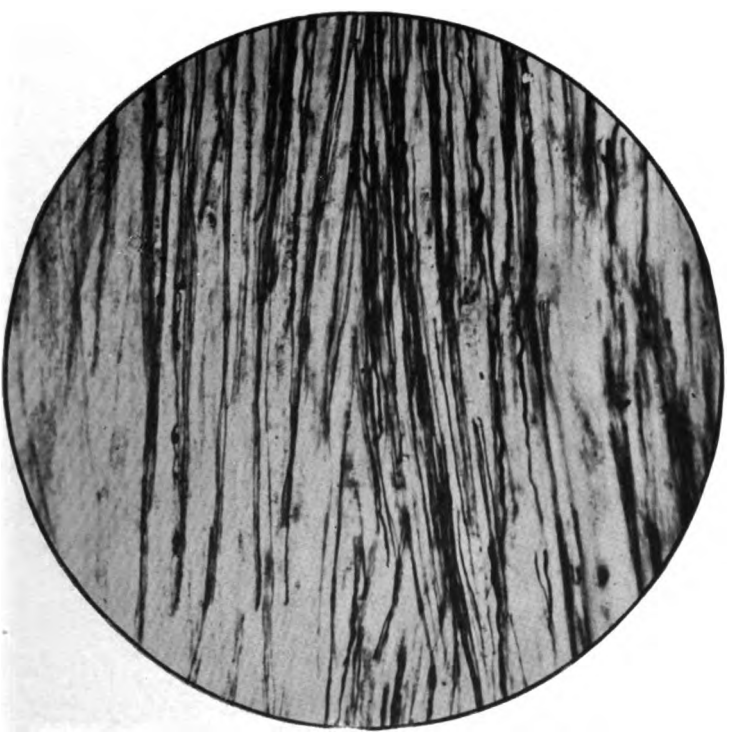

Fig. 8.—Regenerated segment eight and one-half weeks after operation (× 325). End bulbs are seen at the growing tip of some of the axis cylinders. Arrangement in bundles is already well marked.

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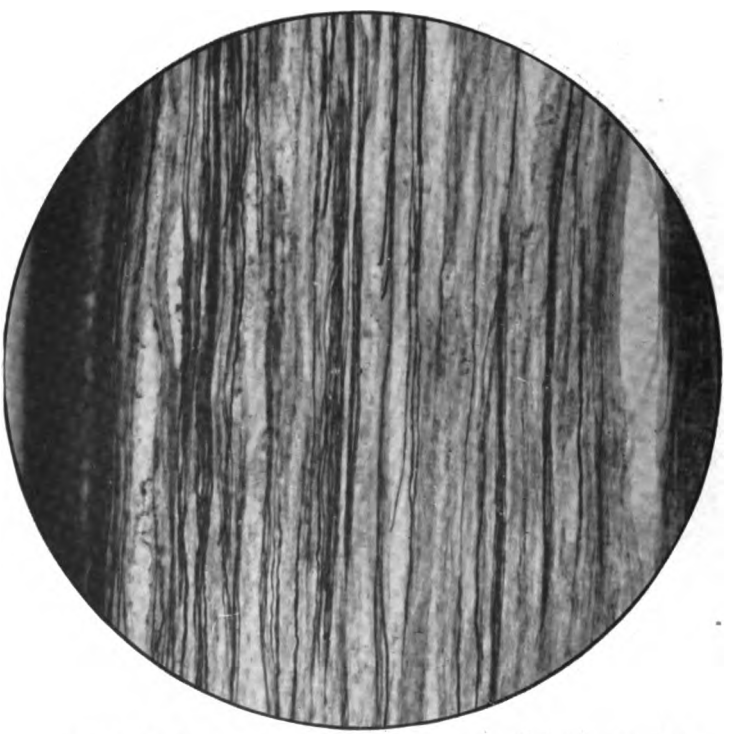

Fig. 9.—Distal segment eight and one-half weeks after operation (× 325). Utilization of old neurilemma sheaths as conduits by newly formed axis cylinders, note also grouping into bundles.

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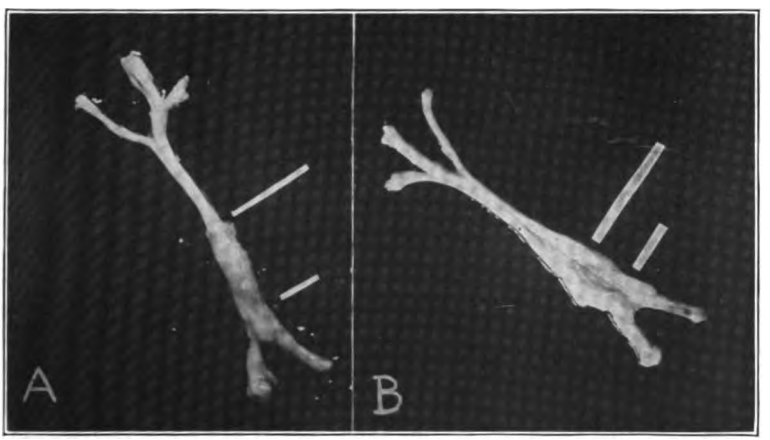

Fig. 10.—*A*, appearance of nerve removed seven weeks after operation, reduced one-half. Lines indicate approximate extent of fascial sheath. *B*, same specimen divided longitudinally. Lines in fascial sheath indicate extent of former gap.

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Fig. 11.—Histologic preparation of fascia at end of sixteen and one-half weeks. This fascia has undergone no cicatricial changes and is in the same condition as at the time inserted. After this length of time no contraction or replacement of the fascia is expected.

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cally. This report is based on the study of twenty-two specimens, the animals having been killed at periods varying from one day to sixteen and one-half weeks after the operation.

Most previous work on nerve regeneration has been conducted on young dogs. We have used dogs of all ages. Casts were used on the first five dogs, but not on any of the remaining.

The histologic technic was the following: Immediately after death the nerves were excised, stretched on glass tubing, carefully orientated and fixed. In general two methods were employed in studying the changes, the most important being the Cajal silver method as modified by Ranson. Other pieces of the nerves were fixed with liquor formaldehydi and Zenker, and stained by Malory's phosphotungstic hematoxylin method. Hematoxylin and eosin were also employed.

CRITERIA AS TO SUCCESS OF BRIDGING

Several criteria indicative of successful bridging have been suggested. Recovery of function, which will occur only after months when resection is made at a distance, cannot be relied on, especially when the experimental animal is a dog and the operation is performed on the sciatic nerve, for fair function returns about as soon as the postoperative tenderness is gone. The rapid return of function is probably dependent on anatomic peculiarities of innervation in the dog. Improvement in the foot drop is probably indicative of successful bridging, but as the axis cylinders have such a distance to travel, a negative result in the earlier weeks does not mean that the defect has not been successfully bridged. We have seen the foot drop disappear completely in one dog after fifteen weeks and in another dog after twenty weeks. The reaction to electric stimulation cannot always be depended on in estimating the amount of repair, for as Forsmann[5] has

5. Forsmann: Zur Kenntniss des Neurotropismus, Beitr. z. path. Anat., 1900, xxvii, 407.

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shown, irradiation of the current may occur, leading to contraction of muscles even when repair is not complete. The best criteria of regeneration are the gross appearance and the histologic findings. All the specimens which we have removed have been carefully examined microscopically, after fixation, and staining methods have been employed to differentiate axis cylinders.

GROSS AND MICROSCOPIC CHANGES OBSERVED AFTER TUBULIZATION

The most interesting changes are observed in the fascial tube. At the fifth day the tube is partially filled with a soft, grayish white pulpy material resembling somewhat in appearance soft gray brain matter. No blood is found, providing hemostasis has been good, an essential to nerve regeneration through a fascial tube. Microscopically this pulpy material is finely granular and homogeneous, evidently coagulated lymph containing a few mononuclear leukocytes. The middle of the tube, that portion most remote from the divided ends, is empty. The microscopic changes in the proximal and distal stumps correspond to those described by Ranson and others in their studies dealing with nerve regeneration, and will be given but brief consideration, except in relation to the bridging of the defect.

In the eight and eleven-day stages the proliferative changes in the proximal stump of the resected nerve are marked. About one half of the medullated axis cylinders have given rise by division and lateral branching to a large number of nonmedullated axis cylinders. These are grouped in bundles of twenty or thirty about the original medullated axis cylinder. These regenerative changes involve the terminal 0.5 cm. of the proximal stump. The newly formed nonmedullated axis cylinders penetrate a little way into the pulpy material which fills the proximal end of the tube.

In specimens examined after two and three weeks a solid downgrowth from the proximal stump has

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invaded the pulpy material. The axis cylinders develop first and most rapidly along the side of the tube, and the nerve end, originally cut transversely, has become oblique. The axis cylinders at this stage have penetrated 1 or 2 mm. further into the ground-work of the tube than would be judged from the gross appearance. During the first week the macroscopic corresponds with the microscopic tip, but from that time on the distance to which the axis cylinders have penetrated is judged with difficulty by the gross appearance.

After four weeks the gap, if 1 cm. or less in length, is completely filled with a firm, pearly white mass, having longitudinal striations. If the gap is longer there will still be found a part of the tube which is filled with a substance softer than the nerve, dark gray in color, into which the axis cylinders have not penetrated. At this period, in the length of gap mentioned above, a moderate number of axis cylinders have completely bridged the defect and invaded the distal segment. The axis cylinders on reaching the distal segment are no longer arranged in bundles. They are doubtless separated while passing through the material filling the tube, but the separation is mostly due to the more rapid advance of some of the fibers than of others, for in the later stages the fibers which have invaded the distal segment are again arranged in bundles.

Even at the fifth week the proliferative changes in the proximal stump and the regenerative changes are very marked. Enormous numbers of nonmedullated axis cylinders arranged in bundles of from twenty to sixty are found. Even as high as 2 cm. above the plane of section, nonmedullated axis cylinders are present in large numbers, but the medullated ones predominate. The advancing axis cylinders end in terminal bulbs at various levels. The axis cylinders which are grouped together are obviously derived from a single axon.

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The axis cylinders and medullary sheaths of the distal segment in the second and third weeks have undergone almost complete degeneration. Active proliferative changes in the neurilemmal cells are found, and the cytoplasm of these cells has become arranged in the form of protoplasmic bands which later will act as conduits for the advancing regenerating axis cylinders. The changes observed in this distal segment are those ordinarily noted after section of a nerve; the myelin sheath being broken up, the axis cylinders absorbed, a homogeneous matrix, evidently protoplasmic band substance being found. In the later stages, from seven to nine weeks, the distal segment contains a large number of nonmedullated axis cylinders, many being grouped to form distinct bundles, while others run singly.

That fascial tubes will remain patent and form a path for developing tissues has been demonstrated in the repair of tendons. Lewis and Davis[6] have had the opportunity of examining a fascial tube which was inserted for the purpose of permitting regeneration of the flexor sublimis and profundus digitorum tendons of the ring finger which had been lost as the result of infection. This tube, which measured three and one half inches in length, had been filled by a tendon developing from each flexor, as was shown when the specimen was examined 255 days after the tube had been inserted.

A serious objection which has been raised against fascial tubulization is contraction. If the fascial tube should undergo a great degree of cicatricial contraction, the purpose of the operation would be defeated, for the newly formed fibers would be strangulated. Fascia is probably not used more frequently for neurolysis because of the fear of cicatricial contraction.

Fascia contracts immediately after being removed. This primary contraction is probably due to the elastic

6. Lewis, Dean D., and Davis, Carl B.: Repair of Tendons by Fascial Transplantation, THE JOURNAL A. M. A., Feb. 21, 1914, p. 602.

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fibers which it contains and can be disregarded because it has reached its maximum by the time the fascial tube is inserted. The contraction which extends over a long period may be called the secondary or cicatricial contraction, and if this occurred to any extent in the fascial tubes, it would preclude the possibility of their use for nerve repair and neurolysis. There is but little secondary contraction if the fascia is sutured into place, and is subjected to the same conditions as regards stress and strain as in the part from which it was removed.

In the experimental work which has been hitherto done to demonstrate this cicatricial contraction, the fascia has been placed about the bowel, and it is probable that the changes in the fascia have been secondary to those in the peritoneum.[7] In this connection it should be mentioned that fascia undoubtedly undergoes cicatricial changes when placed adjacent to scars. Kredel has recently reported a case in which fascia was placed about an injured nerve in which there was a recent scar. Another operation had to be performed later because of pain which increased in severity, and it was found that the fascia had undergone cicatricial changes and was constricting the nerve. Kredel therefore regards it as inadvisable to use fascia for neurolysis. We believe that Kredel should not have used fascia about this recent scar. In such a case it would be better not to have attempted neurolysis, or to have resected the scar and after end to end suture to have performed a fascial neurolysis. Fascia in the presence of a recent scar or hemorrhage tends to undergo cicatricial contraction.

That fascia may be used successfully in neurolysis is indicated by a patient operated on by one of us (D. L.) eighteen months ago. This patient's radial nerve was cut in an automobile accident. Immediate suture was done, but an infection occurred and there

7. Kolb: Deutsch. Ztschr. f. Chir., 1913, cxxv, 399.

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was loss of radial function. In this case the scar uniting the nerve ends was resected at a second operation, and an end-to-end suture performed. A fascial flap was then placed about the line of suture. There has practically been a complete return of function following resection with suture and fascial neurolysis.

To avoid the possibility of cicatricial contraction, a lumen large enough for the developing nerves should be provided. The lumen of the tube in this work has been made approximately twice as large as the ends of the nerve. The fascia at first is much thicker than the perineurium, but in many cases it gradually becomes thinner and finally continuous with it. In some cases after from five to eight weeks, only the black silk orientation sutures remain to mark the original limits of the fascial tube at the ends of the gap. In other cases, as in one at four and one half months, it retains to a great extent its original characteristics; we have not yet been able to determine the factors which control this absorption or nonabsorption of the tubule.

In one case (Dog 17) the fascial tube was made so small that its lumen was less than 1 mm. in diameter, not more than one third of that of the nerve. This dog was killed six weeks and one day after the operation, and it was found that the tube had been converted into a connective tissue mass. But few regenerating axis cylinders had reached the distal stump.

In two cases veins were used instead of fascia. In one (Dog 15), a fresh segment of jugular vein obtained from the same animal was used. This procedure is more difficult than fascial tubulization. The vein wall is thinner and tears more easily when sutured. The specimen was examined after five weeks. Histologic examination showed that the endothelium and tissues of the vein wall had formed a cicatricial tissue which had grown inward and obliterated the lumen. Only a few axis cylinders had penetrated the center. Veins

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furnish no better results than fascia, and the technic of insertion is more difficult and time consuming.

Failures after tubulization may be due to several factors. Hemostasis must be as perfect as possible, hemorrhage from the cut ends of the nerve being carefully controlled, for a blood clot in the tube stimulates a fibroblast reaction which may be followed by dense scar formation. The soft brain-like pulp consisting of coagulated lymph and a few mononuclear leukocytes remains soft for some time and forms a bridge for the developing axis cylinders which is easily penetrated. The tube should not be applied under tension. It should be sufficiently long to be comparatively loose when fixed in position.

The reaction of fascia when placed over a recent scar has been already discussed when mention was made of Kredel's unsuccessful case of fascial neurolysis. In order to avoid the possibility of much scar formation all dissections should be made with sharp instruments, laceration and contusions of the nerve ends and surrounding tissues being carefully avoided.

DISCUSSION OF RESULTS

Defects in nerves may be successfully bridged by fascial tubes. Histologic preparations show that the continuity of the nerve is reestablished. The medullary sheaths have not yet been formed in the specimens examined by us. These are formed late in the process of nerve regeneration.

Regeneration of the fibers which bridge the gap takes place entirely from the proximal stump, as has previously been shown by Ranson, Ranvier, Vanlair and Forsmann.

The proliferative changes in the proximal stump are very active. From fifty to one hundred times the number of axis cylinders normally found in a nerve are formed. If one out of fifty of these axis cylinders enters the empty sheaths of the distal segment it seems certain that both anatomic and physiologic

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restoration of the nerve would occur. It has been demonstrated that a comparatively few axons will permit of functional activity on the part of the muscles supplied by them (Vulpius and Stoffel).

The time required for bridging depends on the length of the defect, also on the age of the animal, and the amount of tension exerted on the nerve ends. We believe that a gap of 1 cm. with proper use of this technic will be bridged in nine weeks, the axis cylinders at this time having passed well into the distal segment.

The oldest observations have been made on animals ten and sixteen and one half weeks after tubulization. Von Fleischhauer[8] in his clinical observations has found that a cicatrix in a nerve usually undergoes contraction seven or eight weeks after injury. In our oldest experiments there has been no evidence of secondary contraction in the tube. It has often thinned out so as to be almost indistinguishable from perineurium. We believe that the possibility of cicatricial contraction of the fascia is precluded when the proper technic is employed and the fascia inserted only under proper conditions.

We are indebted to Margaret E. Kirk for valuable assistance in the experimental work.

ABSTRACT OF DISCUSSION

Dr. A. A. Law, Minneapolis: I think the simplest illustration of the tendency of the proximal nerve fragment to regenerate is shown in the neuroma. Levings showed us how, after resection of a nerve, with implantation of the severed ends between parallel muscle fibers, the proximal fragment sends out axons and causes regeneration. Forsman's theory of neurotropism explains the tendency of the nerve cells to find one another. Dr. Lewis has spoken of the various foreign bodies introduced about these nerve fragments in an attempt to aid regeneration, such as bone or magnesium, cylinders, blood vessels of men or the lower animals, Cargile and eggshell membrane, etc. These are all foreign bodies and as such must be taken care of by the host; and while they give a certain percentage of success, they are not of as much avail as autogenous transplants. The saphe-

8. Von Fleischhauer: Berl. klin. Wchnschr., 1915, lii, 212.

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nous nerve resected and transplanted is interesting, but I am convinced that it is of little value over other methods, as the axons die. The blood vessels are objectionable, of which Dr. Lewis spoke, because they become occluded. In the University of Minnesota we have repeatedly wrapped sutured nerves with fascia or fat flaps. In recently operating on an avulsed brachial plexus, after section of the clubbed ends of the nerves and proper suture, we wrapped one trunk with a pedicled flap of aponeurosis and another with fat. The doctor spoke of the time element. Eight weeks ago we operated for destruction of the musculospiral nerve in a man who had been operated on four times before; after resection of the clubbed ends we found there was destruction of the nerve for three inches. Tubulization was done by fascia lata and at the end of eight weeks there was complete return of sensation and marked return of muscular control of that forearm. This fascial tube permitted nerve regeneration through it. There was a nonunited fracture of the humerus for which a bone inlay transplant was done; so we had two autogenous transplants in contact in the same field. We must conclude, then, that up to the present there is nothing available which parallels the value of fascia lata in aiding the regeneration of nerves.

Dr. John F. Golden, Chicago: In Dr. Murphy's work we have found that the most difficult thing is to get function where we have a defect in the continuity of the nerve. We have gone through the various methods, including muscle implantation according to the method of Levin of Milwaukee, the use of catgut and the transplantation of nerve from the cadaver. The latter method we have found to be a failure. The other methods have been successful in proportion to the length of the defect in the nerve. As a later method of getting function we have been transplanting the tendons of functionating muscles into paralyzed muscles, or into the muscle which is negative through insufficient nerve supply. This has proved the most satisfactory. In neuroplastic work I should like Dr. Lewis to discuss the necessity of approximating like axons. One of the first principles in handling defects in nerves is to cut off the cicatricial neuroma that forms, or the brush-like ends, and prevent or stop any hemorrhage. The regeneration of nerves by the aid of fascial tubulization now seems to be successful, as shown by the histologic sections of Dr. Lewis, and this has perhaps solved the problem of supplying the defect in the nerve, which up to the present has had no real solution.

Dr. Kenneth A. J. MacKenzie, Portland, Ore.: Four or five years ago I handled a case in which there was unusual damage to a large peripheral nerve—a tumor of the sciatic, which grew from the sheath and proved to be a sarcoma of a low grade malignancy. The man complained of severe pains

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in the foot which led to an investigation. To relieve his intense suffering it became necessary to resect the sciatic nerve, and having exposed the tumor, it occurred to me that the procedure indicated was the removal of the nerve. I removed it from the level of the lower border of the gluteus maximus to the bifurcation of the two popliteal branches. Following this operation there was great trophic disturbance and it looked for a time as though the leg would be lost; blebs, bullae and large ulcers formed, and even the nails dropped off, making it necessary to do something for his relief. In this crisis by making an incision from the top of the thigh to the heel I exposed the entire zone of the nerve and found the internal popliteal, traced it to its lowest level and detached therefrom two or three filaments and lifted them up to within a quarter of an inch of the upper truncated end of the nerve, the nerve flap being 16¾ inches in length.

I first made an anastomosis between the internal and the external popliteal at their upper cut ends. With the flap the gap was bridged by its suture with the upper cut end of the sciatic. The only thing that I did to protect the filaments was to cover them with the muscle by means of a delicate suture, and in accord with the principle of tubulization advocated by Dr. Lewis. This I consider a most important step.

The main effect of this first operation was very striking. Almost instantly the trophic disturbance ceased and color and life came back into the leg. Realizing the enormous benefits of this operation, I operated again in four weeks and attacked the external popliteal segment and treated it in the same way, covering the flap with muscle. The long wound healed each time by primary union, so that no harm arose from infections. There was no motion or sensation in the leg for many months afterward. One day, however, he began to manifest signs of slight movement in one of the toes; this continued and sensation reappeared, and after eighteen months of various methods of treatment I took the man to Philadelphia before the American Surgical Association and showed him able to walk unaided, and run, and practically restored to efficiency. He returned to his work afterward. He is here now. I had tatooed on his leg permanently the different zones of lost sensation, which furnish an indelible record, and it is remarkable in this case following the recovery of trophic function, which was immediate, how slowly the protopathic sensibility returned, namely, in four or five months, while the so-called epicritic sensibility took nearly a year before it was complete.

By means of fascial tubulization or hollowed tendons one may promote recovery of function and of sensation and motion, using the method which might seem best at the time. This case would seem to support the principle advocated by Dr. Lewis.

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DR. F. W. RINKENBERGER, Los Angeles: I wish to report a case bearing on this subject, showing benefit from the fascial flap. A man was caught in the gears of a motor boat and had his left arm badly mangled, both ulnar and median nerves being severed. We did a primary suture, getting success with the median but failure with the ulnar, paralysis resulting. He had trophic disturbances over the wound, in the skin, for six months. We grafted twice. At the second operation, after removing the cicatricial tissue, the nerve was too short to unite so there was a question in our minds as to the best procedure. The nerve was transplanted from behind the condyle and passed through a tunnel in the pronator group and then a fatty fascial flap thrown around the point of union, leaving the pedicle attached. The man is an ardent sportsman and I had a letter last week in which he said, "Doctor, I am able to handle my gun for the first time and I have more grip." It is too early for a final report as yet, although apparently successful the second time.

DR. DEAN LEWIS, Chicago: It is a matter of prime importance in nerve surgery to recognize the arrangement of motor and sensory axis cylinders. It seems probable that many of the poor results in nerve surgery are due to our failure to recognize this arrangement. As the degenerated distal sheaths act as conduits for the regenerating axis cylinders, we should have the ends of the fibers in as near a line as possible, for our results will be vitiated if motor axis cylinders pass down the degenerated fibers of sensory nerves. Until we know differently, it is well to preserve this relation, for neurotropism, as far as I know, cannot direct motor axis cylinders into the sheaths of degenerated motor fibers of the distal segment, and we have to depend on good alignment to secure this result. I believe that the good result in Dr. MacKenzie's case is due to the muscular tubulization which he performed when he sutured the muscle about the nerve fibers employed in the neuroplastic operation. Muscle has been used for tubulization, but it has its disadvantages. In the first place, muscle is subject to contraction and relaxation when in action, interfering with the caliber of the tube. A tube can be formed from fascia which will conduct nerve fibers and will not contract. The supply is practically unlimited and the fascia can be removed without interfering with function of the part from which taken — decided advantages over any other kind of autoplastic material.

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CHRONIC INTESTINAL STASIS WITH INFECTION FROM A SURGICAL POINT OF VIEW

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Patients with chronic intestinal stasis with infection who reach the surgeon, have, as a rule, exhausted the ingenuity and patience of the family physician, the gastro-enterologist, the neurologist and even the oculist. They have been victims of the patent medicine habit, and have tried all the isms and pathies in medicine. They may have resorted to a change of climate and some of them even to a change in religion. During their dreary pilgrimage many of them have acquired surgical experience, including, perhaps, as some one has aptly said, "mobilization of most of their fixed organs and fixation of most of the movable ones."

In dealing with one of these patients it is important to know whether, prior to the development of the present illness, he or she was a comparatively normal individual, as rarely happens, or, as is usually the case, a neurotic subject with deformed body, and viscera presenting wide variations from the average normal in position, size, structure and function. The previously healthy individual whose illness has its origin in some serious constitutional disease, or is due to a break in the general health from some other cause, such as a severe infection of the intestinal canal, perhaps involving the appendix, is not likely to require any more serious operation than an appendectomy, or, possibly an appendicostomy to allow complete flushing of the bowel. The tendency in such

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cases is to recover under good management. They present no very serious problem. In considering intestinal stasis from a surgical point of view, therefore, we are concerned almost exclusively with physically deformed patients whose nervous systems are unstable and who suffer from a general visceroptosis and who show in varying degree the evolutionary bands, kinks, folds and membranes about the terminal ileum and colon concerning which so much has been said. These individuals, of course, present a lowered resistance to morbific influences in general, and are unable, except under favorable conditions, to withstand the ordinary wear and tear of life.

In spite of gross abnormalities, the colon and terminal ileum, in such a case may, within reasonable limits, meet all of the individual's needs from the point of view of functional usefulness. That such is the case is amply attested by the fact that most visceroptotic persons live to old age in comparative comfort unless their feeble powers of resistance are overtaxed in some way, as for example, by severe infection, an improperly balanced diet, or prolonged mental or physical strain. Constipation, from which most of them suffer, of course, predisposes to infections in the intestinal canal, yet a vast majority of these patients apparently suffer no ill effects from constipation even when their bowels are not emptied more than once or twice a week. The constipation, per se, does not seem to make the patient ill.

The dire results said to be due to downward dragging of a displaced and overloaded colon and terminal ileum on the mesentery, in cases of visceroptosis, are probably greatly exaggerated, for the reason that the weight of the abdominal viscera is not supported by their mesenteric attachments.

It seems probable that the constipation, the atony and distention of the cecocolon and the stasis in the terminal ileum from which these patients suffer, are

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all the result of imperfect development of the musculature of the bowel, mobility and displacement of the cecocolon, and a defect in the nervous mechanism which controls the intestinal movements.

It has been suggested by E. A. Barkley, A. F. Hertz and others that the deformed, atonic, distended and displaced cecocolon is unable to supply the muscular contraction necessary to make the constriction point or temporary sphincter at the junction of the cecum and ascending colon, which normally forms during the occurrence of a general peristaltic wave, and by thus holding the back pressure, prevents regurgitation, and that as a result of the defect, these patients suffer from back pressure and stasis in the terminal ileum and cecum. However this may be, it seems that the individual does not suffer any ill effects from constipation until the walls of the colon or ileum have, from some cause, become infected. Even in the presence of infection it is not likely that the patient's health will be seriously broken unless the local immunizing mechanism of the bowel wall is overcome and the protecting influence of the other body defenses, such as the liver, spleen and glandular system, has been impaired by some cause, which may not necessarily be directly associated with the bowel condition.

Many of these patients, after they have been infected, in time reach a point where they can be helped only by surgical means. It is a problem to decide when they have reached this stage.

Surely the mere fact that an individual is the possessor of deformed and displaced viscera does not mean that he is a subject for surgery as soon as he becomes ill from the results of intestinal infection, nor does the fact that he suffers from obstinate constipation, associated with intestinal infection and toxemia, mean that he is beyond nonsurgical help. The study of the history will show that he has been constipated all his life, and that never until the

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development of his present illness has the intestinal stasis seemed to cause any serious trouble. Furthermore, investigation will often show that in the immediate family there are other individuals of the same type who also suffer from constipation and yet are about as well as neurotics can expect to be. The fact that the family physician has not properly understood the problem this case presents, and has therefore not obtained a good result, does not prove that the patient requires a surgical operation, and lastly, the mere fact that the patient has become demoralized and demands an operation should not influence us.

Surgical interference should be avoided in these cases as long as possible. Fortunately, much can be done for them by nonsurgical means, but they are preeminently institutional cases and require careful study and prolonged treatment. Many of the most markedly deformed and visceroptotic and apparently hopeless patients can, as J. E. Goldthwaite suggests, be cured by braces, posturing, massage, exercise, stimulating, bathing, etc. They can be relieved of intestinal stasis and from the infection, and be made comparatively strong, well-poised and vigorous. A voluminous laxative diet and the intelligent use of psychotherapy will produce regular and normal bowel movements and great improvement in a surprisingly large number of cases. Strapping of the abdomen for support, or the use of close-fitting, well-constructed corsets with abdominal pads, will solve the problem caused by diminished intra-abdominal pressure and compensatory dilatation of the abdominal blood vessels, as suggested by E. Schulz. Frequent colon irrigation and the liberal use of paraffin by mouth and by rectal injections left in the bowel to be carried to the upper colon by antiperistalsis, are useful. Dilatation of the rectum and sigmoid is to be employed in cases in which there seems to be a tendency to obstruction in the lower bowel.

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It must be borne in mind that in many cases the enteroptosis and intestinal stasis and infection are not the sole cause of the patient's ill health. For example, some are suffering from unsuspected syphilis or other constitutional disease. Cases of intestinal stasis with infection and toxemia are primarily not surgical cases and if properly treated, very few need ever become surgical. It seems that in the treatment of these cases we are going through another surgical fad period that will end as did the oophorectomy craze, the nephropexy mania and the round ligament round-up.

There are, of course, some cases in which surgical interference offers the only hope, and in these cases the selection of the surgical procedure to be employed is of the utmost importance.

There doubtless are cases in which a colectomy, either complete or partial, offers the only possible hope for relief. It is likely, however, that if these operations were reserved for cases that could not be helped by any less radical means, the results would be disappointing.

In considering short-circuiting operations we must bear in mind that we are dealing with a problem in physiology and not one of simple gravity or plumbing. Colon stasis and infection are not always relieved by such an operation, and ileum stasis and regurgitation are apt to be increased. This work is still in the experimental stage. To be sure, there are many reports testifying to brilliant results, but certainly the number of these does not yet equal the enormous number of cures formerly obtained by kidney fixation, kidney decapsulation, round ligament suspensions, removal of the ovaries and many other surgical triumphs of the recent past. Already warnings against useless mutilation of the intestinal tube are coming from every section of the country, where the end results of short-circuiting operations are being observed.

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The ideal operation in these cases must, of course, be one that will secure easy and complete emptying of the bowel, thus relieving the toxemia; it must relieve the back pressure and reflux into the ileum; it must provide a means for the treatment of the infection; it must effect a cure of the chronic appendicitis; it must avoid any unnecessary mutilation that will destroy the future functional usefulness of the colon and ileum.

To accomplish all this, the distended, atonic and displaced cecum must be restored to its normal position and fixed there. It must be reduced to its normal size and some means provided by which infection in the entire colon and terminal ileum can be treated, and by which back pressure can be relieved. If the bowel is obstructed by bands of either evolutionary or inflammatory origin, these must be removed. Blake's method for reefing the cecum down to normal, and Wilm's plan for fixing it in position, do not meet all the indications for the reason that the cecocolon is still atonic, its walls infected and in no condition to withstand back pressure, or to offer any adequate assistance to the forward movement occurring during peristalsis. A simple appendicostomy, even when done in addition to a reefing down and fixation operation on the colon will not do, for the reason that the tendency of the cecum to a downward displacement stretches the attachment made by the appendix to the abdominal wall, and allows the anterior and external wall of the cecum to bulge forward again, and soon the cecum is out of its fossa and in the pelvis.

All indications for surgical treatment in these cases seem to be covered by the following very simple procedure, which it has recently been my practice to follow:

Through a long right rectus incision the entire colon and terminal ileum are carefully freed from adhesions or bands that seem to threaten obstruction. The ceco-

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colon is pleated down to normal by Blake's method, and the appendix, with, if possible, a tent-like portion of the cecum around its base, is drawn up into a large stab wound so placed that the cecum is *firmly fixed* in the abdominal wall. The parietal peritoneum is dissected back from the margins of the stab wound to make sure of a firm fixation. The base of the appendix being well up in the wall, it is possible to dilate the lumen until it will admit a large catheter through which the bowel can be rapidly flushed and through which the fluid remaining after flushing can be siphoned off. By this plan we (1) overcome obstruction; (2) replace the cecocolon; (3) reduce it to normal size; (4) fix it in position; (5) provide a means by which back pressure on the atonic bowel wall can be relieved; (6) provide a means by which the infection in the bowel can be successfully dealt with, and (7) dispose of the diseased appendix.

This method is simple and free from risk, and, while it perhaps presents nothing very new, it at least has the merit of seeking to preserve the functional usefulness of the colon and the ileum.

CONCLUSIONS

1. In considering intestinal stasis from a surgical point of view, we are concerned almost exclusively with neurotic and visceroptotic subjects who are unable, except under the most favorable conditions, to withstand even the ordinary wear and tear of life.

2. Obstinate constipation and lowered resistance predispose these patients to infection, which, however, may not do serious harm unless the local immunizing mechanism of the bowel wall and the protecting influence of the other body defenses have been overcome.

3. Cases of intestinal stasis, even though infection and toxemia are present, are primarily not surgical cases, and if the patients are properly treated, very few need ever become surgical. They are, however,

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preeminently institutional cases and require prolonged and careful treatment.

4. No operation that will destroy the future functional usefulness of the bowel should be done in the cases that can be helped only by surgical interference.

5. The cases which colectomy, either partial or complete, seems to relieve for a time, could probably be relieved permanently by much less radical means.

6. Short-circuiting operations are, as a rule, to be condemned. These operations are still in the experimental stage and the number of brilliant results apparently obtained, do not yet equal the number of "cures" formerly reported from kidney fixation, removal of the ovaries and other now discredited surgical triumphs of the past.

7. The ideal operation must: (1) secure easy and complete emptying of the bowel; (2) relieve back pressure, and reflux into the ileum; (3) provide a means for the treatment of the infection; (4) effect a cure of the chronic appendicitis, and (5) preserve the functional usefulness of the colon and ileum.

1516 Main Avenue.

ABSTRACT OF DISCUSSION

DR. J. N. JACKSON, Kansas City, Mo.: As a result of interest inspired by Metchnikoff and the doctrine of Lane, has come our interest in this field of surgical endeavor. I believe no one of experience or intelligent observation has reached the stage in which he is willing to declare that any fixed decision of this matter has been made. We are going now through a stage in which there are some factors of progress, and, on the other hand, there are some things we do not know and which we must be careful in coming to a conclusion about. We must be conservative in dealing with these cases of intestinal surgery. We know more about the physiology of the colon, and it must be dealt with as a piece of mechanical plumbing. We may have colonic stasis from several different fundamental conditions. We have a certain class of cases in which the defect is in the nervous mechanism of the individual, which defect is inherited, and it is impossible for any one by mechanical means to alter it. There are classes of cases in which the trouble

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is due to a primary and mechanical obstruction to the outlet of the intestine, and I have found many cases in which there was a positive mechanical interference with the action of the colon. I have seen a true toxic condition without any interference with peristalsis. There are classes of cases in which there is a positive derangement of a toxic type. We find cases of old chronic appendicitis in which the person never had an acute attack, with a raised leukocyte count, etc., and after the appendix has been removed we have seen the most remarkable transformation of the person. A great many acute surgical conditions of the appendix become surgical because of the inability of the appendix to expand and supply blood to take care of the nutrition of that part, and we have chronic appendicitis. There are many cases in which we have chronic septic infection of the colon. Are they suffering from intoxication or infection? I think there are both types of cases. Ordinarily they can be recognized by the history. The cases of septic infection are the doubtful cases, and I believe that surgery should not be applied in any condition in which we can get results from conservative methods, by internal medication, etc. It might not have been fully demonstrated that these cases are of chronic septic infection of the colon; then anything done to the outside is going to do good. We must do something to get rid of the infected segment of intestine. We are dealing with a class of patients who have been sufferers from a medical standpoint, and who will ultimately yield to some surgical measure.

Dr. Robert C. Coffey, Portland, Ore: In 1906 I reported in The Journal a case of severe intestinal stasis as having been cured by ileosigmoidostomy. A year later I had to remove the colon because of reverse peristalsis into the cecum. A year later the patient came back and wanted the rectum taken out. A friend of mine circumcised him instead and claimed he produced a cure. Since that time I have done a good many operations of the colectomy type and some few of the short circuit type, but have come to the conclusion, by seeing a considerable number of these cases both from the medical and surgical standpoint, that any operation which involves the opening of the lumen of the intestine is to be avoided except in very rare and extreme cases. From Dr. Jones, my partner, we have learned that most of these cases can be cured without any surgical interference, by proper dietary and forced feeding treatment. In postoperative Roentgen-ray examinations of these patients who have been short circuited for true intestinal stasis, there has been reverse peristalsis, later requiring removal of the colon. The normal patients who have been short circuited for ordinary habitual constipation do not need removal of the colon and do not have reverse peristalsis. There are a number of patients whom we have short circuited for fistu-

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las, high obstruction, etc. In these cases we have had no backing up into the cecum. We have noticed that the ileum is always dilated following the short circuiting operation, whether it has been cut off from the cecum or not. When we have operated the second time in cases in which the cecum and first half of the transverse colon had been removed at a previous operation, we have always found a dilated ileum and in some cases fecal matter extending up into the ileum three feet or more. There is undoubtedly a difference of intestinal pressure in the large and small intestines, and the ileocecal valve is of importance. While we have brilliant results in some cases after short circuiting or colectomy, we find we must follow our surgical methods up by medical treatment and by regulation of habits and diet. As soon as normal intra-abdominal pressure is established, followed up by hygienic measures, most cases of stasis are relieved without any surgery at all. They cannot be handled in the private home and hospital; they must be handled by specially trained people. We have had a few cases which have not been cured by medical means before operation, but which have been cured by the same means as soon as the hepatic flexure and first part of the transverse colon had been replaced and held by sutures. They do not need a short circuiting operation or colectomy of any kind, except in very rare and exceptional cases.

DR. REA SMITH, Los Angeles: I wish particularly to indorse the statement of Dr. Russ that most cases of intestinal stasis are medical, and I agree that operation should be reserved for the medical failures. I want here to make a plea for a better understanding of the indications for short circuit. When anyone mentions short circuit and colon constipation in the same sentence he is making a mistake. Short circuit of the ileum is designed to relieve stasis in the ileum and will have no effect on stasis in the colon (or constipation). When you deal with stasis in the small intestine you must drain the ileum in order to get rid of toxemia, and if the colon evacuates itself every day before operation it will continue to do so afterward. You cannot, however, expect to relieve colon stasis, which is constipation, by a procedure designed solely to drain the ileum, and if marked constipation exists before short circuit it will probably continue afterward.

Concerning fixation of the cecum, we have found that when the cecum and ileum are prolapsed together and movable, the resulting stasis can usually be cured with a properly fitting corset. Any stasis in the ileum and cecum that can be controlled by mechanical supports does not need surgery, and these results are more brilliant than the surgical ones. When the cecum is bound down by adhesions it is much more difficult to lift the prolapsed ileum with a mechanical support than when both cecum and ileum are

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freely movable. I rather doubt the wisdom of fixing the cecum unless something is done with the prolapsed ileum at the same time, as I think it would be more likely to cause stasis in the ileum than cure or prevent it.

Dr. F. W. Rinkenberger, Los Angeles: After some time spent with Mr. Lane in 1911 I could not believe all the ills of the human body are caused as he believed. I took a series of healthy young men and demonstrated with the Roentgen ray absolutely the same pictures as he was showing as stasis. This report was never published. Now remembering that the stomach is a movable organ and the colon also, I have never convinced myself it was proper to operate where an obstruction was not demonstrable to the eye, any more than in the past to operate on so-called mucous ulcers of the stomach when they could not be demonstrated. Most of these persons have what I call unstable nervous systems, and no matter what you do for them they are like cases of epilepsy which are reported cured, but come back. I believe that the great majority of cases of short circuiting are rarely justified.

Dr. John William Draper, New York: In collaboration with my associate, Dr. J. M. Lynch of New York, I made a careful study of the cecum and the ascending and transverse colon in thirteen human specimens, and it may be of value to this section to know what were the anatomic and microscopic findings in these cases. Without going into detail, I will say in the first place that we found the arrangement at the ceco-ileac junction to be very similar in all cases, in that the mesenteries were all of the nonfused type, being unusually long and common to both the small and the great intestine. In some cases there were other variants which could be ascribed to heredity. We were unable to find any means of discovering these anatomic conditions before opening the abdomen, but perhaps later on the Roentgen ray will give some further assistance along this line. Microscopic conditions were interesting: three of the cecums showed almost entire absence of mucous membrane; three showed well-defined papillosis, and in all, the musculature was very much attenuated. Not a single one corresponded to our conception of normal. The defensive mechanism was evidently greatly weakened. These cecums were large and of the herbivorous type. In contradistinction to the cecocolons of this type, we believe that the terminal colon is of very great importance to the economy. Some experimental work in the lower animals which we have done has shown that it plays an important part in the excretion of certain poisons, some of which, as in acute intestinal obstruction, are undoubtedly liberated by the economy itself. While it may be true that the cecocolon may and probably does under normal conditions take active part in water absorp-

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tion, and to an inconsequential degree in food absorption, these functions are easily vicariously assumed by the terminal ileum. This we have proved by animal experimentation and by the study of six ileostomies made in human beings. We therefore feel that total colectomy should be avoided on physiologic grounds, except in certain very rare instances. The individuals in which we did the partial resection of the cecocolon were all human derelicts and had been treated medically for many years before operation.

DR. ROBERT T. MORRIS, New York: Most of these patients who are subjected to the short circuiting operation are patients who should have had their ancestry short circuited by one or two generations. You are dealing with a class in which there are many other stigmata; you are dealing with patients with defective ductless glands; with patients who do not maintain a proper balance between their organs. You have in these cases an example of the fact that function is closely associated with structure. Many of these patients are "cured" by the various cults, and you have brilliant results no matter what you do if only you report your cases quickly enough. The fact is that these patients are very amenable to suggestion, and suggestion is potent in helping for the time being in restoring the tone and balance of the innervation of the enteron. We are going to have more and more of these cases for the reason that our nation is approaching cultural limitations. In the history of evolution every former nation has reached cultural limitations and then declined. We begin to have certain anatomic defects classified as stigmata associated with a psychology which is the expression or manifestation of the anatomic defects. These cases, many of them, are really cases for surgery for the reason that we often have a secondary group of toxic manifestations which are amenable to surgery. We now know from our study of focal infections that a focal infection in the colon may give rise to distant effects. It is merely a question of properly making an analysis, and in the cases in which the focal infection may actually be located in the colon, the patient may be relieved by some of our resources, either medical or surgical, which will allow us to gain control of that feature of the case.

In regard to adhesions, many of them are due to toxins, with distant manifestations. We have adhesions which require surgery sometimes. Lane and I happened to publish our studies on these subjects in the same year, 1903. His paper appeared in the London *Lancet* and mine in the *Medical Record,* but Lane received most of the attention, because his kink was where it was easily observed. The cobwebs up in the attic of the abdomen which I described are worthy of attention, which will be given them in due time. These cases are more often medical than surgical; but do not neglect the surgical features.

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DR. W. B. RUSS, San Antonio, Tex.: The so-called neurasthenic patient who suffers from a general visceroptosis and obstinate constipation presents a lowered resistance to morbific influences in general. Infection originating in the bowel wall may, if neglected, result in a condition that will require surgical interference for the purpose of securing easy and complete emptying of the bowel, the relief of back pressure, for providing a means for the treatment of the infection, and for curing the chronic appendicitis from which they all suffer. No operation should be employed that will destroy the future functional usefulness of the colon or ileum. The simple method I propose seems to meet the indications.

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INTESTINAL ADHESIONS

BOWEL PROTECTION

W. B. BRINSMADE, M.D.
BROOKLYN

It seems to be an accepted fact that intestinal adhesions may occur after any abdominal operation. We recognize bacterial invasion, trauma, blood clot and irritation of the peritoneum as the causes of intestinal adhesions. We are unable to control bacterial invasion due to disease. Modern operative technic is able to prevent the contact invasion of bacteria from stumps and diseased areas to a certain extent. Trauma to the intestines may be minimized by following the best possible technic. We have left, then, irritation to the peritoneal coats of the intestine, which so often accompanies operation, as the element of danger which should be eliminated. The prevention of injury to normal organs lying adjacent to the field of operation is the phase of the subject which I desire to bring before you.

EFFECTS

Intestinal adhesions may or may not cause serious symptoms. It is not always possible to draw positive conclusions from a fluoroscopic examination or from a roentgenogram of the intestines loaded with bismuth. What appears in the pictures as a mass of dense adhesions may not have caused very definite symptoms. The gallbladder and stomach may be adherent and give practically no distress in one case, while a similar condition may bring about chronic invalidism in another case. In many instances the small intestines have been found to be bound together and still functioning fairly well. So, too, we

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have incidentally recognized some cases of angulation of the sigmoid which have caused no symptoms. Therefore, as a general statement, we may say that intestinal adhesions are not of themselves necessarily productive of harm, at the same time acknowledging that very slight adhesions may lead to a condition of marked invalidism and danger. Certain individuals seem to create adhesions in the abdomen more readily than others.

PREVENTION

Admitting the frequency of intestinal adhesions after laparotomy, and recognizing that adhesions between the omentum and abdominal peritoneum follow many incisions through the abdominal wall, and that operations on all hollow viscera are followed by localized peritonitis, I was led to the consideration of methods of prevention and the question of protection to the intestines not in immediate contact with the site of operation.

It is interesting to note the diversity of methods employed by various operators. During a trip in Germany in the summer of 1912 I remarked that no moist pads or gauze were used. Everything was dry. Several surgeons were seen to use ten strips of gauze a yard wide. One surgeon would have the bowel packed off. Another, while he had one pack in the abdomen, left the bowel uncovered, not shielded from touch. In one instance the bowels were unprotected in a case of hysterectomy for cancer. In general, however, the incline of the table was so great that less packing off of the bowels was needed than is the custom with us. One operator I remember seeing, this time not a German, who became so enamored of the packing process that he used 25 yards of gauze before he finished his operation.

I have been convinced for a long time that pads of gauze left in contact with the omentum or peritoneum for any period of time might lead to adhesions,

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and such a theory was strengthened by the following observations. Four years ago I operated on a young woman suffering from acute appendicitis. The intestines were greatly distended and she took the anesthetic badly. Two moist gauze sponges were placed about the ileum and coils of the small intestine to hold them within the abdomen. The convalescence was normal, but was followed by increasing constipation with pain over the site of operation, which terminated a year later in an acute obstruction, with gangrene of the ileum necessitating resection. The patient finally recovered. About the same time I saw in consultation a young man who had been operated on five days previously for appendicitis. He had had several attacks and the operation was performed in the interval, a sound appendix being removed. Several gauze pads had been placed in the abdomen to facilitate operation. The lad was suffering from acute obstruction. The second operation disclosed the ileum firmly attached to the caput and colon for a distance of 3 inches corresponding to the area which had been in contact with the gauze pads. The third patient traced her illness to a period following an abdominal operation for retroversion. Pain and gastric symptoms developed one month after the operation and she had been invalided for a year. The roentgenogram showed an hour-glass stomach which at operation was found to be fixed and drawn down with the transverse colon by a tense omentum. Freeing the omentum from its broad attachments, well down, relieved the deformity in the stomach and the patient was cured of her symptoms. Inquiry developed that the first operation was performed with the patient flat on her back. The omentum had been pulled down around and covering the intestines and then wrapped around with several gauze pads which were in contact with the intestines and omentum about twenty-five minutes. It seems fair to hold the gauze pads responsible for the complications in these three illustrative cases, even admitting the possibility of local infection and biochemical changes.

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With these cases in mind we have eliminated the use of laparotomy sponges as much as possible, never placing them in actual contact with the bowel. One or two large sheets of gum rubber are used next the intestine and the gauze pads placed on the rubber. The rubber slips out of place easily and is a nuisance to the operator but the protection afforded overbalances the disadvantages. To determine the value of this procedure several dogs were operated on, under ether anesthesia, with the same technic that was used on our patients. Moist gauze sponges or sheets of gum rubber were used. All the dogs recovered promptly. They received water the first day and were fed regularly thereafter. A thick covering of collodion protected the external wounds, all of which healed kindly.

Dog 1: Splenectomy and enterotomy. The abdomen was open for one hour and five minutes. Three sponges were in the abdomen at one time. The spleen was removed, the mesentery being ligated in two sections. A wound was made in the intestine near the junction at the ileocecal valve, and repaired with linen Lembert sutures. The laparotomy sponges were in the abdomen thirty-five minutes. The omentum was brought down and spread around the abdomen and the wound closed in layers. Necropsy was performed on the ninth day. The abdominal wound had healed and no sign of peritonitis was present. The omentum was adherent to the parietal peritoneum and to the intestines over the entire abdomen. The site of splenectomy was marked by a mass the size of a hazelnut; no adhesions were around the mass. The coils of intestines which had been packed off were adherent to the adjacent coils. The site of the enterotomy was covered by dense adhesions plastering the neighboring intestine.

Dog 2: Splenectomy and enterotomy. The abdomen was open forty minutes. No laparotomy sponges were

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used, a sheet of pure rubber gum being substituted. The operation on the first dog was repeated as nearly as possible in the second dog. The necropsy, performed on the ninth day, revealed the abdominal wound healed; no sign of peritonitis; the omentum free. The site of splenectomy appeared as in Dog 1. There were no adhesions along the coils of intestine. The site of the enterotomy was marked by adhesions to one adjacent coil or intestine which was also attached to the omentum. Both of these dogs had been well and active following the operation.

Dog 3: Intestinal anastomosis. Three inches of the small intestine were resected; the ends of the intestine were inverted and covered with continuous linen sutures. A lateral anastomosis was then made. The coils or intestine not concerned in the operation were packed away with gauze pads. The abdomen was open for thirty minutes. Necropsy, performed on the ninth day, showed the abdominal wound healed and no peritonitis. The omentum was firmly adherent to the parietal peritoneum not only at the site of incision but throughout the belly. The coils of small and large intestine were found matted together. Figure 1 shows the animal suspended by the hind legs. The intestines are adherent and do not drop up against the diaphragm, being held in place by adhesions. The omentum is seen adherent to the peritoneal wall. Parts of three ribs have been excised in order to show the liver. In spite of the dense adhesions this dog showed no symptoms after operation. He was running around just like any happy well-fed dog and without interference with his appetite. The bowels had moved regularly.

Dog 4: Hysterectomy; double ovariotomy. The intestines and omentum were packed off from the pelvis with gauze sponges for twenty minutes, isolating the parts to be operated on. Both tubes and ovaries were removed, and supravaginal hysterectomy was performed, care being taken to cover the raw surface with

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peritoneum. Necropsy on the tenth day showed the wound healed; no peritonitis; omentum adherent to the parietal peritoneum throughout the abdomen; strong adhesions between sigmoid and stump of uterus. Two coils of intestine in the neighborhood of the cecum were found bound together by adhesions covering an area of three-fourths inch (Fig. 2). There were no other adhesions.

Dog 5: Hysterectomy; double ovariotomy. The operation on Dog 4 was repeated on Dog 5 except that a sheet of gum rubber was used to isolate the intestine instead of gauze pads. The time of operation was the same, twenty minutes. Necropsy on the tenth day found the wound healed; no peritonitis, omentum adherent to the parietal peritoneum only at the suture line; no other adhesions except at one point where a catgut suture remained unabsorbed in the stump of the uterus. This dog was suspended by the hind legs when photographed and the intestines fell into the upper abdomen, being perfectly free to move into the position governed by gravity (Fig. 3).

Dog 6: Gastrotomy. Incision 2 inches along the anterior wall of the stomach. Gauze sponges were placed to isolate the field of operation. The wound in the stomach was closed with catgut suture. Necropsy on the seventh day revealed adhesions of the omentum to the line of abdominal incision and a spread of omentum plastered to the wound in the stomach. A mass of strong adhesions was also present at the junction of the ileum and the caput. The entire colon and sigmoid flexure were loaded with feces, and there was a general injection of the peritoneal coats of the intestine.

Dog 7: The same operation and the same procedure were followed in Dog 7 as in Dog 6 except that a sheet of gum rubber replaced the sponges. Necropsy on the seventh day showed the wound healed; no peritonitis; omentum adherent to line of incision with a

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small area of wound infection around one of the catgut sutures. The omentum was plastered over the wound in the stomach exactly as in the dog previously operated on. This dog showed at necropsy a decidedly more normal looking abdomen than did the previous one.

At my request the department of surgery of the New York University made experiments on six dogs. All the dogs were eviscerated. In three cases the intestines were protected by gauze sponges and in three cases by rubber dam. The abdomens were open about fifteen minutes. At necropsy adhesions were found in all the dogs, but the report is decidedly in favor of the rubber dam. Evisceration is about as severe a test for this method as one can find.

It would seem fair to conclude from these experiments that, in these dogs at least, sheets of gum rubber did less harm than gauze pads, and to conclude further that if the human peritoneum resembles that of the dog, sheets of gum rubber will do less damage to it than gauze pads. There is nothing original in the use of this material. I first saw it used in the late Dr. Charles Jewett's clinic twelve years ago.

In many instances we have found it possible to avoid putting anything in the way of either gauze or rubber into the abdomen during operation and this I believe to be the best technic of all.

To operate in all cases in which the diagnosis of intestinal adhesions has been made and in which the history points to that graphic picture of intestinal stasis, so well known to us all, will lead to many disappointments. I have seldom been successful in curing the symptoms of patients on whom I have operated for intestinal stasis due to adhesions. There is a class of adhesions, however, which demands operative relief. The adhesions occurring after appendectomy and which give the symptoms of intestinal obstruction, of course demand immediate operation. Whether active peristalsis after operation tends to prevent adhesions

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or whether stasis of the intestinal tract accomplishes this purpose better, I have not been able to decide. Much has been written on this subject on both sides of the question, ably and forcibly asserted and maintained.

Our greatest success in dealing with adhesions has been with those occurring in the upper abdomen. We have had a number of cases in which the gallbladder and pyloric area were found glued together with adhesions. In three instances this probably was due to cholecystitis occurring at the time of typhoid fever; in other instances it was due to duodenal ulcer. We have followed the plan of separating the organs which were attached and not making a dissection of the rest of the adhesions. In my most successful cases a piece of omentum or omental fat has been grafted between the organs. The cases in which extraneous substances were used as protection to the traumatized intestines were in general not successful. Aristol powder, because of its sticking quality, appeals to me more than any other substance.

Since writing this paper Dr. W. H. Barber has, at my request, carried on further operations at the New York University. He has experimented on six dogs in pairs, doing the operations of splenectomy, gastro-enterostomy and nephrectomy and reports as follows:

The results of intra-abdominal operations and using gauze or rubber dam have not in our hands been as conclusive as in the first series. Indeed it is surprising that no adhesions were found any where in any dog excepting at the posterior abdominal wound or at the site of intra-abdominal operation.

In conclusion, then, I would say that dry sponges do more harm than moist sponges, and that the rubber dam does less harm than moist sponges, and that least damage of all is done to the intestines if packing can be avoided entirely.

117 Montague Street.

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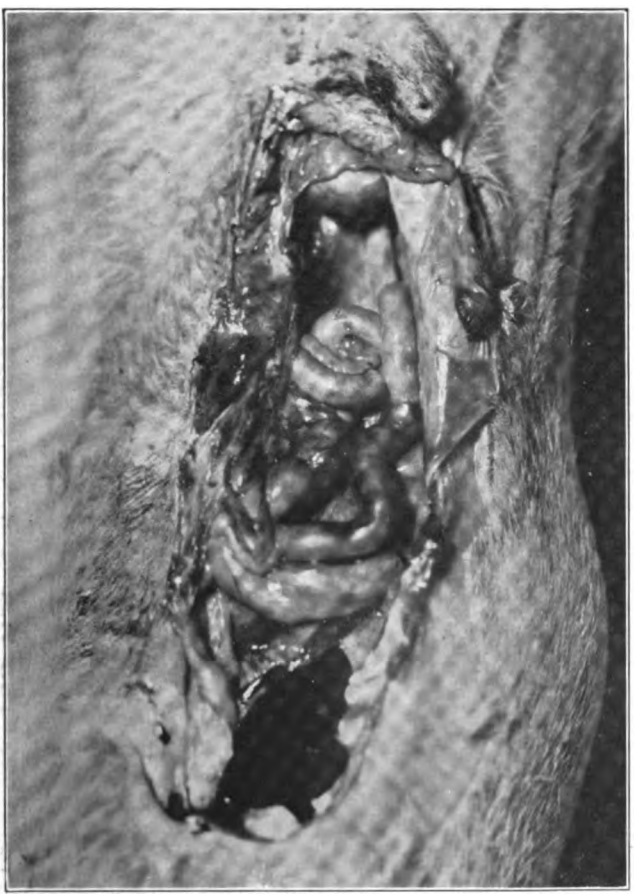

Fig. 1.—Intestinal anastomosis showing adhesions due to gauze sponges. This and the following illustrations show dog suspended by hind legs.

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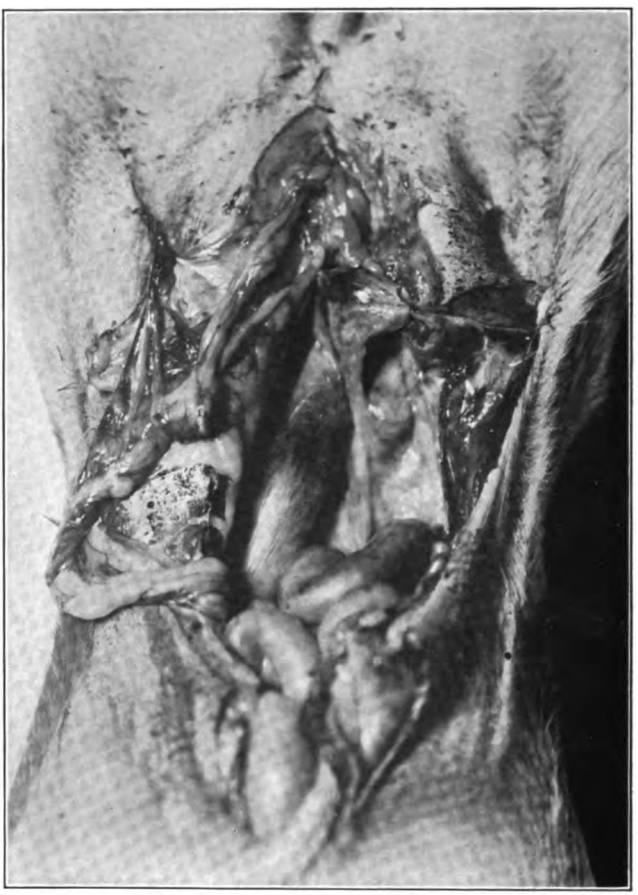

Fig. 2.—Double ovariotomy and hysterectomy done with rubber dam in place of gauze sponges. No adhesions. Intestines have fallen against diaphragm.

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Fig. 3.—Double ovariotomy and hysterectomy showing adhesions due to gauze sponges.

UNIV. OF MICH.

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ABSTRACT OF DISCUSSION

DR. A. S. LOBINGIER, Los Angeles: The speaker has told us intestinal adhesions may exist for a long time without the patient having any serious embarrassment. A certain number of adhesions will result after nearly every operation. These usually disappear in the course of two or three years. There are important points in the refinement of technic and in the method and system by which we proceed with an abdominal operation which seem to me should always be kept in mind. Intensifying the anesthesia as we open the abdomen and decreasing it after we have everything settled and the field exposed are of prime importance in abdominal operations. We must allow the anesthetist to help us in reducing the trauma. The surgeon should plan his operation with such system and method as to know what he is going to do and do it quickly and deftly and avoid unnecessary handling of viscera. There are some cases in which the omentum is more involved and a larger serous surface is exposed than in others. Where we have to expose extensive surfaces of endothelium and it becomes necessary to put back large coils of intestine as in hysterectomy, it becomes a very much greater problem than in a simple appendicitis how we shall protect the endothelium and prevent adhesions. Since there has been a great reduction in neisserian infections, since we know how better to manage all pelvic, gastric and colonic infections, we may expect a decidedly decreasing number of adhesions in the abdomen. A number of months ago I wrote a letter to some twenty prominent American surgeons who had large clinics, as to what their experience had been in the use of iodin in the preparation of the skin and its effect in producing adhesions in the abdomen, brain and large joints. Practically all of them answered. A New York surgeon of large experience had abandoned its use because he thought three deaths in their clinic could be directly traced to adhesions resulting from its use. A representative surgeon in the West considered it a very effective and searching germicide which probably became a neutral iodid in its reaction with the blood. A majority of the surgeons favored its use, but all urged careful towelling off of the skin surface from the endothelial field. Several years ago in a visit including the principal clinics in Canada and the Eastern United States, I was astounded to see iodin used in almost every clinic I visited. It was used freely, with apparently little thought of the danger to the endothelium of the joints and intestines. I should like to emphasize the point Dr. Brinsmade has made that we should avoid needless trauma and antiseptics of any kind; but where we cannot avoid a certain amount of handling, in so far as possible we should minimize the trauma by handling viscera with fragile endo-

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thelial covering just as delicately and as little as is consistent with honest and thorough work.

Dr. A. F. Jonas, Omaha: Peritoneal surfaces, visceral and parietal become adhered to one another with surprising rapidity and in varying degrees of firmness. The adhesions may be limited to single points or be universal, involving apparently all intestinal surfaces. They may be of a most disabling character, threatening life in the face of apparently moderate adhesions, and again they may be universal and yet intestinal functions may appear to be retarded to a very limited degree. We may be no more amazed at the most extensive and rapid intestinal and visceral agglutinations than at the rapid disappearance of the same. In the one case, very extensive adhesions may be beneficent, and in the other they may be fatal. The clinical manifestations bear no relation to the extent and degree of the adhesions. We have learned that they might be life saving or life destroying according to the mechanical obstacles.

The most common irritants as they concern us are chemico-bacterial and mechanical. The first is usually preoperative and has to do with the primary pathologic process and the second usually depends on the surgical manipulations and is postoperative. Considering postoperative adhesions, assuming that we have aseptic, nonadherent surfaces to deal with, we must plan every abdominal operation so as to insure a minimum amount of handling and pulling on the organ or organs that may be the object of operation. The incision should, as nearly as possible, be immediately over it. It should be ample and, when indicated, the gentlest manual exploratory search for other pathology than the one of our primary attack should be quickly carried out. The surgeon must know his landmarks in order to insure unnecessary meddling and that he may quickly bring to the surface without undue traction the structures that he seeks. He must avoid evisceration. The prolonged exposure to the air of the intestines makes them soggy and soon dulls the peritoneal surfaces, producing one of the factors that we wish to avoid. Too many intra-abdominal pads compress and may contuse the intestinal walls, threatening endothelial injury. The repeated introduction and withdrawal of gauze packs during the intra-abdominal operation traumatizes peritoneal surfaces and visceral walls.

The method of protecting the intra-abdominal pads with large sheets of rubber is undoubtedly of value, and they no doubt produce less irritation than free gauze pads. If they can be so adjusted that they will hold all intestines out of the field of operation they certainly fulfil an important function. The smooth rubber surfaces will undoubtedly cause less peritoneal friction than other sponges. They certainly deserve an extended trial.

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DR. L. S. PILCHER, Brooklyn: How often have we seen apparently an absolute forgetfulness on the part of an operator that it was possible to insult the peritoneum? It has been manipulated and pulled on and subjected to friction as if it was nothing more than a piece of smooth glass. Let us not forget, however, that it is one of the most sensitive of surfaces and that the amount of surface that is presented to us is such that our manipulations may do it most extensive damage. One of the cardinal principles in all surgical work is that to obtain an end the least amount of violence required to attain that end should be used. On the other hand, is it not true that to obtain an important end no amount of violence that is essential to accomplish this end shall be spared? These two principles, therefore, every surgeon must always have in mind. It may be best to use abdominal packs or do without them, but whether we shall do without or use many of them or a moderate amount must depend on the judgment of the individual operator and the particular case in hand. Are adhesions to be avoided? Not always. Often adhesions are that for which we seek and for which we are operating. Adhesions may be temporary and vanishing, due to small superficial endothelial abrasions, or they may be permanent, due to loss of the endothelial layer and exposure of the deeper strata. Added to this are the permanent adhesions due to bacterial invasion, which are the source of many extensive adhesions often encountered. As to the particular suggestion of Dr. Brinsmade to lessen the amount of irritation to which the peritoneum should be subjected when opened, such particular suggestions are not new to us. We have seen the peritoneal surface smeared with unguents and baptized with oils and various membranes spread on, and even powders scattered over the peritoneal surface to prevent adhesions, but as we know now, most certainly to produce adhesions. The use of the rubber sheet suggested by him certainly has the advantage of simplicity but it may add difficulty to the technic. The laboratory experiments which have been presented to us do not seem to be absolutely convincing.

DR. W. I. TERRY, San Francisco: For over two years we have been using Pope's solution of sodium citrate and sodium chlorid and we have been much pleased with the effect of it. We use a hypertonic solution in large quantities which appears to minimize adhesions, with most excellent results, as several relaparotomies have shown.

DR. JOHN WILLIAM DRAPER, New York: I assisted Dr. Barber in doing the work on the last series of dogs mentioned by Dr. Brinsmade, and wish to say that it served to emphasize in our minds very strongly the necessity for using the utmost gentleness, and the protective method

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described by him was particularly efficacious. We should not lose sight of the fact that there is an important biochemical element in this matter of adhesion formation, and it seems to us, and this Dr. Brinsmade has already said, that the ratio between the fibrolytic element and fibrogenetic element in the individual being operated on is the real, fundamental factor, and this, as yet, we have no means of measuring. This does not detract from the importance of handling the tissues with the greatest gentleness, but rather adds to it.

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MALIGNANT DISEASE OF THE LARGE INTESTINE

A PLEA FOR EARLY DIAGNOSIS AND EARLY RADICAL OPERATION

H. BEECKMAN DELATOUR, M.D.
BROOKLYN

The study of malignant disease has been diligently pursued for many years. Large funds have been set aside for the purpose of research and much experimental work has been done in these diseases, but as yet we are not in possession of any positive knowledge as to the cause. Not knowing the cause little can be done in the way of prevention. As we can not exert the ounce of prevention we must strive to obtain the pound of cure. In all cases of malignancy the probability of cure is directly related to the earliness and thoroughness of removal.

Childe[1] insists that further improvement in the results of operations for cancer is chiefly to be looked for in the systematic education of the public; that it should be taught that early cancer is curable by operation, and that early cancer produces no symptoms of pain or ill health. We believe that these facts must also be more forcibly placed before the family physician, and those so unfortunate as not to believe in operative procedures must be converted. In cases of doubt exploration should be urged, for the clinical evidences of internal cancer become manifest only in the later stages of the disease.

It is easy to educate the public as to superficial growths, tumors in the breast and possibly ulcer and

1. Childe: Brit. Med. Jour., July 20, 1907.

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cancer of the stomach. Growths in the intestinal tract are so insidious in their development that the patient cannot be expected to aid in its discovery. We must look to the general practitioner for the early recognition of these tumors.

Cancer may occur at any point in the large intestine, but is most common at the sigmoid and the rectum and next at the cecum. The growth may be either carcinoma or sarcoma, but the former is by far the more common.

Tuberculosis of the hyperplastic form may easily be mistaken for cancer and is equally as serious a condition to deal with.[2] It is most likely to occur at the ileocecal junction and frequently involves the bowel at more than one point.

SYMPTOMS

Unfortunately the symptoms of cancer of the bowel are not very definite and many cases are brought to our hospitals as emergency cases to be operated on for acute intestinal obstruction, while the cause of the obstruction is a tumor which has been growing for many months, or perhaps one or two years.

No single or special group of symptoms appear in all cases, but the diagnosis must be deduced from a careful analysis of the entire case.

The disease occurs in patients beyond the age of 35, rarely earlier than this and most frequently beyond 50 years.

One of the most constant symptoms is constipation accompanied by flatulence. Constipation is usually obstinate and the patient finds it necessary to constantly increase the amount of physic to get the desired results. As the constriction of the bowel becomes more marked, pain or cramps develop, caused by the efforts of the intestine to overcome the obstruction. Diarrhea frequently alternates with constipation.

2. Kandt: Long Island Med. Jour., April, 1915.

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If the patient is thin or has lost much flesh the peristaltic waves may be easily observed through the abdominal wall. The pains are usually intermittent and the point of greatest intensity is at the site of the obstruction.

Obstruction of the bowel comes on so gradually that frequently it becomes complete before the true condition is suspected. In some instances this is due to the lodging in the small opening of the intestine of some solid or undigested particle of food.

The symptoms of intestinal toxemia are present in nearly every case, and it is not easily remedied by the usual medical means. This is due to the stasis produced by the partial obstruction. Anorexia is frequently a prominent symptom and occurs quite early.

Loss of flesh and weight are present, as in all cases of cancer, but we have seen cases in which the patients have apparently retained their normal weight. Increasing weakness is present in most cases.

Cachexia does not usually appear until the disease is well advanced.

Vomiting does not usually appear until obstruction has developed.

Blood and mucus in the movements are valuable signs when present, but unfortunately are not observed unless the growth is in the rectum or lower sigmoid.

Ulceration with perforation may take place in the bowel wall immediately above the growth before obstruction has become complete. We have seen this in a number of cases in which a localized but spreading peritonitis caused the patient to seek medical aid.

Diagnosis in the early stages is not easy and, as we have already stated, is often not made until signs of complete obstruction appear.

Blood analysis is of some aid. In obstruction of the bowels the leukocyte count is always higher than normal, and when obstruction is nearly complete may

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be as high as 20,000 to 25,000, while the polymorphonuclear count may not be above 65 or 70 per cent. The changes of secondary anemia will be present.

Carcinoma skin reaction as proposed by Elsberg, Neuhof and Giest, and later studied by Lisser and Bloomfield,[3] is said to give a positive reaction in from 70 to 89 per cent. of cases of cancer and in only 8 per cent. of noncancerous cases.

Abderhalden's ferment diagnosis may be of considerable help. Goodman[4] has reported thirty successful diagnoses in thirty-three cases of suspected cancer.

Observation of the abdomen will frequently disclose to sight and touch the exaggerated peristaltic action of the intestine. When present this is a positive sign of stricture.

The absence of a palpable tumor is not to be taken as a negative point in diagnosis.

Roentgenographic examination, combined with the use of bismuth by mouth and by injection, is frequently of great value. Case[5] states that when cancerous obstruction is present the following may be observed: (*a*) Delay in the passage of the bismuth varying from forty-eight hours to several days; (*b*) arrest of the bismuth given per anum; it must be shown that failure to fill the colon beyond a certain point is not due to want of pressure or to the presence of fecal masses; (*c*) dilatation of the bowel on the proximal side. The shadow may end in a funnel-shaped process when the obstruction is by ring stricture or by irregular lines due to the obstruction of a fungaceous mass in the lumen.

In using the enema the progress should be watched on the screen and any point of obstruction noted.

Even in early carcinoma it will be found that the head of the column halts at the site of the tumor and

3. Lisser and Bloomfield: Bull. Johns Hopkins Hosp., 1912, p. 356.
4. Goodman: Surg., Gynec. and Obst., December, 1914.
5. Case: Interstate Med. Jour., xx, 1103.

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the distal colon distends under the pressure. Later the bismuth may be seen to slowly pass through the point of observation.

PROGNOSIS

After removal of cancer of the bowel we believe the prognosis is better than for carcinoma in other parts of the body, the superficial cancers of course excepted.

The infected lymph nodes, as a rule, lie close to the bowel and visceral metastasis is very rare.

The nearer the anal margin the growth is situated the less favorable is the prognosis, for the last portion of the rectum is directly connected with the inguinal glands and these early become infected.

Treatment is surgical and consists in a thorough removal of the growth with the adjacent lymphatic glands. The exact procedure must vary according to the location of the tumor. In cases in which complete obstruction has already developed no attempt at removal should be made until the bowel is emptied of its contents. In some the bowel above the point of obstruction may be cleared by repeated lavage combined with abstinence of food by mouth. If the patient's condition permits, the lavage may be repeated several times. In the cases in which a small opening through the tumor has become blocked, this reversal of peristalsis will occasionally dislodge the small mass and reestablish the flow through the intestine. Should this occur, further attempts to clear the bowel may then be made by administration of full doses of castor oil.

In other cases the distention is very great and immediate relief must be afforded. In these a colotomy should be done on the proximal portion of the large bowel and then after a few days of thorough drainage combined with irrigation of the lower bowel the more formal operation for the radical removal of the tumor may be made.

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In the presence of marked distention or impaction of the bowel above the tumor, resection should never be attempted until this condition has been relieved.

Removal of malignant growths in the large bowel may be successfully accomplished even after they have reached a considerable size, as they do not tend to form early metastases. Even with a knowledge of this fact we should make a thorough removal, including with the growth as much more of the intestine as may be necessary to include all glands that might possibly be infected. In determining how much bowel is to be removed we may well be guided by the studies of Jamieson and Dobson[6] into the distribution of the lymphatic vessels and glands, and of Clogg[7] on the arterial supply of the large intestine as indicating the limits of resection. The lymphatic glands of the large intestine are scattered along the course of the blood vessels, namely, the ileocolic, the right colic, the middle colic, the left colic and the inferior mesenteric.

In malignant disease of the cecum or ascending colon the portion of the bowel supplied by the ileocolic artery should be removed, that is, the terminal six inches of ileum together with the ascending colon to the hepatic flexure (Fig. 1).

If the growth be at the hepatic flexure the removal must include, in addition to the preceding, that portion of the bowel supplied by the middle colic artery, that is, to the middle of the transverse colon. In removing these portions of the large bowel care must be taken not to injure the duodenum, which is immediately behind (Fig. 2).

Growths at the splenic flexure require ligature of the left colic artery and as much of the bowel as is supplied by this vessel. These growths are rather difficult to remove because of the high attachment of

6. Jamieson and Dobson: Ann. Surg., 1909, L, 1077.
7. Clogg: Lancet, London, Oct. 3, 1908.

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the colon at this point, but it usually can be accomplished through mobilizing the bowel by division of the peritoneum as it passes on to the lateral abdominal wall (Fig. 3).

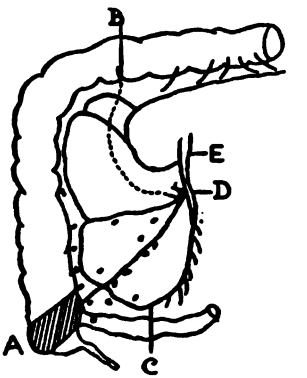

Fig. 1.—Excision of growth in cecum. *A*, growth; *B*, line of section of colon; *C*, line of section of ileum; *D*, point of ligation of ileocolic artery; *E*, middle colic artery. (After Jamieson and Dobson, Ann. Surg., L.)

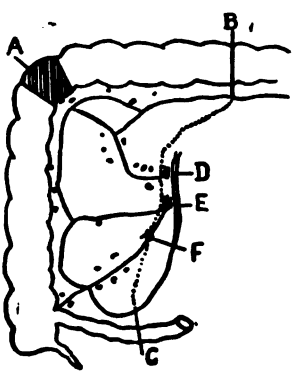

Fig. 2.—Excision of growth at hepatic flexure. *A*, growth; *B*, line of section of transverse colon; *C*, line of section of ileum; *D*, point of ligation of middle colic artery; *E*, point of ligation of right colic artery; *F*, point of ligation of ileocolic artery. (After Jamieson and Dobson.)

In all cases that portion of the fatty tissue adjacent to the intestine and blood vessels must also be removed, for in this are the lymphatic glands (Fig. 4).

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The sigmoid flexure and first portion of the rectum are to be considered together as they have the same blood supply, the inferior mesenteric, and develop from

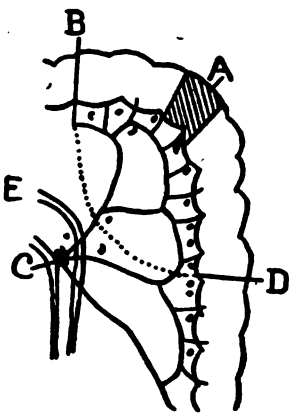

Fig. 3.—Excision of growth at splenic flexure. *A*, growth; *B*, line of section of transverse colon; *C*, point of ligation of left colic artery; *D*, line of section of descending colon; *E*, inferior mesenteric vein. (Jamieson and Dobson.)

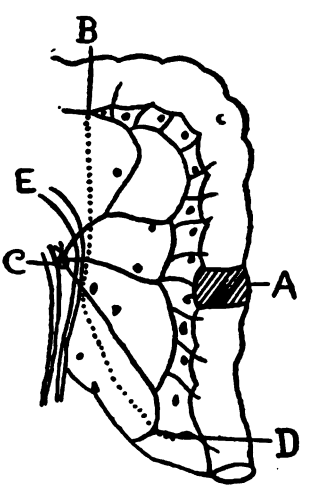

Fig. 4.—Excision of growth in descending colon; *A*, growth; *B*, line of section of transverse colon; *C*, point of ligation of left colic artery; *D*, line of section at sigmoid flexure; *E*, inferior mesenteric vein. (Jamieson and Dobson.)

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the same embryonal tissue. The inferior mesenteric glands drain this area and a free removal of the intestine both above and below the growth should be resorted to (Figs. 4 and 5).

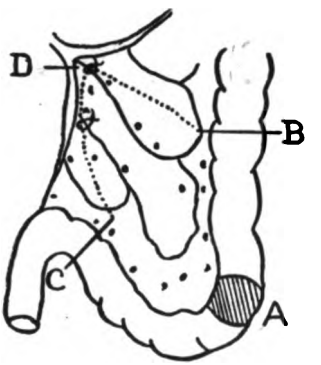

Fig. 5.—Excision of growth in middle sigmoid; *A*, growth; *B*, line of section above the growth; *C*, line of section below the growth; *D*, sigmoid arteries tied at their origin. (Jamieson and Dobson.)

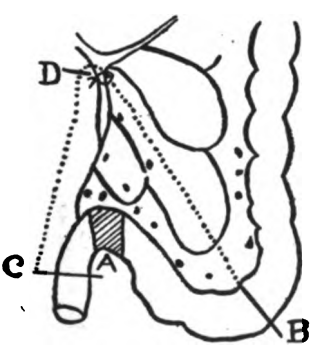

Fig. 6.—Excision of growth at the junction of sigmoid and rectum; *A*, growth; *B*, line of section through sigmoid; *C*, line of section through rectum; *D*, point of ligation of inferior mesenteric artery. (Jamieson and Dobson.)

In case of growths of the rectum there has been a division of opinion as to the best method to follow and as to the production of an abdominal or a perineal anus.

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Fig. 7.—Author's colostomy apparatus.

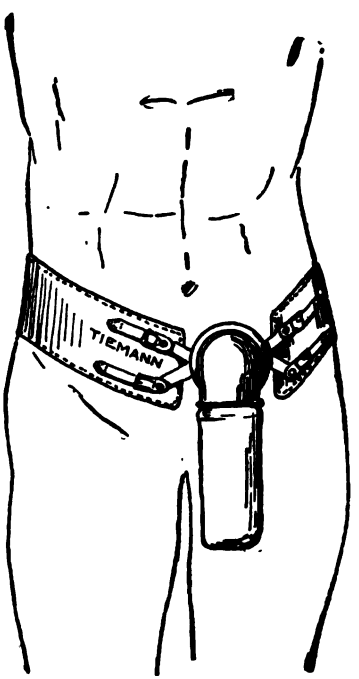

Fig. 8.—Author's colostomy apparatus with receptacle in position.

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As experience has grown, the almost unanimous verdict is now in favor of abdominal colostomy with the intestine brought through the rectus muscle. The successful production of a functionating perineal anus is so rare after a sufficiently radical removal of the disease that it is not to be considered. In an attempt to obtain it one is liable to fall short in the removal of the disease. With a properly fitted receptacle, such as we have devised, patients can be perfectly comfortable with the bowel opening on the abdomen.

As to the method of operating for rectal cancer my own preference is for the combined abdominal and perineal routes, preferably done in two stages. The technic of operation is not here described because many excellent articles have been already devoted to it.

Our object in presenting this communication is to draw the attention of the profession to the frequency with which cancer occurs in the large bowel, to the relatively low degree of malignancy and consequently high percentage of permanent cures after radical operation.

I desire to urge the general practitioner to investigate thoroughly all cases of obstinate constipation; to study carefully the cases of intestinal indigestion with symptoms of toxemia, especially in patients over 35 to 40 years of age; not to regard lightly the escape of blood from the anus, and not to think that hemorrhoids alone may be a cause; to examine more frequently the rectum with finger and speculum, especially when there is obstinate constipation or bleeding from the bowel, and in cases suspected of constriction of the bowel to employ roentgenoscopy by both plate and fluoroscope combined with bismuth injection.

Finally I urge exploration in suspicious cases that, if necessary, early radical operation may be performed.

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A TWO-STAGE COMBINED ABDOMINO-SACRAL OPERATION FOR CARCINOMA OF THE RECTUM*

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There has probably been more discussion of carcinoma of the rectum in England, during the last two or three years, than in any other country, largely because of Mr. Sampson Handley's[1] statement that in a particular case, which he reported, the disease very early invaded the perirectal tissue, and the lymphatics of the bowel wall itself, for as much as 5 inches from the primary growth. In a letter published later, he calls attention to the fact that he did not state that carcinoma of the rectum always did this, but was very much pleased that his statement had brought about the discussion which he had hoped it would.

This statement has given rise to discussion of the relative values of the posterior operation, and the combined abdominoperineal operation; also many statements as to the comparatively benign character of these growths.

It has been stated by some of the older men that, because of this comparatively benign character, and because metastases take place late in the course of the disease, the simpler posterior operations are sufficient.

Mr. Paul[2] of Liverpool said, "Why should we undertake an extensive excision of the mesentery, for the removal of glands, which in all probability are not infected?"

* From the East Surgical Service of the Massachusetts General Hospital.

1. Handley, Sampson: Brit. Med. Jour., 1910, i, 927.
2. Paul: Brit. Med. Jour., July 27, 1912.

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Mr. Harrison-Cripps,[3] in support of his statements, quotes his own excellent statistics, that is, 39 per cent. of three-year cures, but is this a fair impression, unless we go farther and consider that he examined 445 cases, and operated in only 108 of them? In other words, of the patients seen by Mr. Harrison-Cripps, only 9 per cent. may be said to be alive three years later.

Henri Hartmann[4] collected 1,665 cases, with a mortality of 16 per cent. The result known in 982 cases was: Sixteen per cent. died from immediate effects of the operation, 58 per cent. died within three years of metastases, and 26 per cent. lived three years or more. That is, if the same proportion of patients seen were operated on, as in Mr. Harrison Cripps' series, but 6 per cent. of the patients seen were alive three years later.

May we not say, then, without exaggeration, that while carcinoma of the rectum may be a comparatively benign disease when seen early, and that metastases may take place late in its growth, it is one of the most fatal forms of carcinoma, when seen by the surgeon, and operated on by the posterior operation?

If I may be allowed to, I should say that the posterior operations have been popular because of two fallacies: First, they have been adhered to by some of the older men, because these men have deluded themselves into believing that carcinoma of the rectum is a comparatively benign disease, and rarely invades the surrounding tissue. Secondly, men have been led to believe that because they could get sufficient bowel to make a sacral anus, or do an end-to-end suture, after resecting the growth by a narrow margin, they were doing an extensive operation, and did not stop to consider that they were leaving the mesentery, with its lymphatics.

3. Cripps, Harrison: Brit. Med. Jour., Oct. 5, 1912, p. 843.
4. Hartmann, Henri: Jour. de chir., December, 1913.

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The first of these fallacies I have already disposed of. The second can be demonstrated by calling attention to the fact that the inferior mesenteric and superior hemorrhoidal arteries make a straight line, from the aorta to the fixed portion of the rectum, just below the promontory. It will be evident, also, that it is impossible to tie the vessel above the promontory; therefore, in order to bring the bowel down, the vessel must be tied and cut close to the bowel, and below the promontory. In doing this, the main lymphatics from the rectum are cut across, and left in situ with the artery, from the promontory up. It has been my misfortune to find perirectal growth, or metastatic glands in this region, in quite a proportion of cases, which must have been left by the posterior route. Mr. Harrison-Cripps admits that his recurrences took place at the line of suture, and in the glands in the immediate neighborhood.

Would it not be reasonable, then, to take a stand between that of Mr. Sampson Handley, and those who believe that a limited operation is always sufficient, and accept Mr. Cheatle's[5] view, who, after a careful study of serial sections of the whole rectum and surrounding tissue said, "I would advise extensive removal of the bowel where possible, but the result of the examination of my cases gives definite scientific reason to hope for a successful issue from a limited removal of the intestine, in cases which are obviously unfit for extensive and dangerous operations."

We will all agree that the posterior operation is the operation of choice in many cases, but must we not admit that our results with the posterior operations were not satisfactory; and if we do admit this, what can be done to improve them?

There are two methods open to us, first, the education of the laity, and profession; second, improvement of our technic. The first of these is of far greater

5. Cheatle: Brit. Med. Jour., 1914, i, 303.

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importance than the second; a little education will save a great many more lives than a great improvement in technic.

Can any one doubt the necessity of educating the laity, and profession, when the average duration of prominent symptoms in patients entering the Massachusetts General Hospital was eleven months; that 75 per cent. of the patients had been treated for a longer or shorter period, for hemorrhoids; and that the other 25 per cent. were treated for diarrhea? Cancer of the rectum may be a comparatively benign disease, and probably does metastasize late; but is not eleven months of definite symptoms longer than one could expect even a carcinoma of the rectum to remain local? It should not be understood from this that there is any definite time limit in which a carcinoma becomes inoperable, for cases which give a history of symptoms for two years are not infrequently operable.

To improve this condition, the laity and medical profession must be taught to consider every case of hemorrhage from the rectum as cancer of the intestinal tract, until it is proved not to be.

The medical profession and laity know that hemorrhoids are the usual cause of bleeding from the rectum. The laity, therefore, delays about going to the physician, he in turn hears the story, and says without thought or examination, "hemorrhoids," and delays until the patient's condition is such that he knows there must be something more than hemorrhoids wrong with his patient; and finally, when it is too late, the physician sends the patient to the surgeon, or simply palliates the symptoms, because of his, the physician's, dread of a colostomy.

Physician after physician has excused himself on the ground that he could not make a rectal examination, for fear of losing his patient. On the other hand, patients have told me that they have threatened to leave their physician unless a rectal examination was made.

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In passing, may I call attention to the manner of making rectal examinations? The "routine" examination of the rectum, as it is generally made, is worse than useless; because so superficial, it is often misleading. Mr. Harrison Cripps says that no protoscope is needed to make a diagnosis of carcinoma of the rectum, as any carcinoma of the rectum can be reached by the examining finger. I would add to this that few carcinomas can be felt by the examining finger, as the examination is ordinarily made.

Besides fighting against this ignorance of the public in regard to the seriousness of blood from the rectum, and the carelessness of the profession in regard to rectal examinations, we must educate the physician to believe that the artificial anus is not so terrible as he at present believes. This dread, we believe, is exaggerated beyond reason, as patients rarely complain seriously of the discomfort of the artificial anus, if they are relieved of their former symptoms. Many contented patients are doing their regular work cheerfully, with an abdominal anus; it is usually the ignorant who do not appreciate their hopeless condition, before operation, who complain.

I believe that many patients are never brought to the attention of the surgeon by the physician, because of this dread of an artificial anus. It is not at all an infrequent occurrence for patients, with seemingly favorable cases, to refuse operation, because they are seconded by the family physician in their idea that death is preferable to a colostomy. Is it fair for those who are in excellent health, and especially physicians, to decide, without sufficient data, such a serious question? I believe not, for the great majority of those who have actually been placed in this position seem contented after the colostomy has been done.

Education must be the means by which we make our greatest strides in the treatment of cancer of the rectum; but we must at the same time see that the technic of our operation is the most effective possible.

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That the earlier, or posterior operations, were not entirely satisfactory is evident. The combined abdominal and sacral operation is, I believe, admitted to be theoretically superior, but has yet to be proved so practically. There is very little use in quoting statistics in regard to the combined abdominosacral operations, for these statistics appear to be of little real value as yet. It may be stated, however, without exaggeration, that the proportion of three-year cures is larger than with the posterior operation. It is quite evident also that the mortality is much higher.

Chalier and Perrin[6] collected 187 cases, with a mortality of 44 per cent.; they also collected 208 cases, by surgeons who had operated on from six to twenty-six patients with a mortality of 40 per cent. When I quoted these statistics to a friend from Chicago, he said that they were absurd. Perhaps they are today, but if they are, it is largely because of a more careful selection of cases.

Granted, however, that, in a condition such as this, the mortality is high, what does it matter if we can cure a larger percentage of cases than by the posterior route?

Perhaps the most important consideration, in connection with the abdominosacral operation, aside from its greater extent, is that a very much larger proportion of cases seen will be found operable than by the posterior operation, the percentage of operable cases with the posterior operation probably ranged between 20 and 30 per cent.; with the combined operation, this should be increased to 50 per cent. It is worthy of note, in this connection, that many cases which appear to be favorable for operation when examined below, have metastases which make them inoperable, when the abdomen is opened, and many of those which appear inoperable at the examination below are quite favorable when examined through the abdomen.

6. Chalier and Perrin: Lyon chir., February and March, 1913.

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If we are to carry out the technic for malignant disease, as we do in other parts of the body, we must remove the growth by a wide margin, and with it, *en bloc,* the lymphatic systems connected with the region. This, as I have shown above, cannot be done by the posterior operation, so well as by the combined. While this is true, it must be admitted by all that the posterior, or Kraske operation, is the operation of choice in the obese, the feeble, and those over 60 years of age.

There would be very little argument, we think, against the more extensive operation, that is, the combined abdominosacral, provided we could reduce the immediate mortality to that of the posterior operations. This can be done, we believe, by the two-stage operation, without losing any of the important benefits of the one-stage combined operation.

Several two-stage operations have been devised. Among the more important are those by W. J. Mayo,[7] Dalghren,[8] and Coffey.[9] The simplest form of the two-stage operation is that of W. J. Mayo, in which the first stage consists of a colostomy. The second stage is an amputation of the rectum by the sacral route. The distal portion of the sigmoid is left as a pouch, with its lower end closed, attached to the colostomy wound. This idea was essential, as will be seen later, to the two-stage operation to be presented.

In any two-stage operation we must find some method by which the extent of the operation shall be essentially that of the one-stage combined abdominosacral operation; that is, it should include as much of the lymphatic systems of the rectum as possible, and still leave sufficient blood supply to make it positive that the distal portion of the sigmoid shall not become gangrenous, between the first and second stages of the operation, and sufficient to supply the sigmoid, if that

7. Mayo, W. J.: Ann. Surg., August, 1912.
8. Dalghren: Zentralbl. f. Chir., March 29, 1913.
9. Coffey: Ann. Surg., April, 1915.

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is to be brought down after resection of the growth. Practically all the two-stage operations with which we are familiar fall short in one of these two particulars. Dalghren, in order to avoid gangrene of the distal sigmoid, left the vascular arches intact. At the same time he left the main course of the rectal lymphatics by leaving the superior hemorrhoidal and inferior mesenteric arteries untouched above. Coffey avoided the dangers of necrosis after tying off the vascular arch by invaginating the distal portion of the sigmoid into the rectum, a process hardly possible in many cases. It will be seen that in both these operations very little more is accomplished than can be accomplished from below. In both, a sufficient length of bowel can be removed with ease, but there is no more extensive extirpation of mesentery and lymphatics than with the Kraske operation.

In what may be called the second type of two-stage operation reported by Dr. W. J. Mayo,[7] there is some dissection done from the abdomen, the superior hemorrhoidal is tied high, and the vascular arch is tied. In order to avoid gangrene of the upper rectum and lower sigmoid, he leaves the sides of the pelvis untouched, that the lateral sacral and middle hemorrhoidal arteries may supply the bowel above. He reports one case of perforation of the bowel, among the cases in which he used this method.

It has been my effort, therefore, to devise an operation in which an extensive operation could be carried out and still maintain the blood supply to the bowel between the first and second stages of the operation, and to supply any portion which it might be desired to leave.

I wish to present a two-stage combined abdominosacral operation which I now use with the greatest satisfaction.

The first stage begins with a median abdominal incision under ether anesthesia. The sigmoid and descending colon are mobilized, and the inferior mesenteric

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is tied just below the left colic branch. A long silk tie is left on the distal end, in order to identify it in the second stage of the operation. The peritoneal flaps are next dissected from the mesentery of the lower sigmoid and rectum, care being taken to keep at least an inch from the bowel, as recommended by Miles,[10] to avoid the chain of glands just beneath the bowel. These flaps are dissected back to the ureters, which are identified. The whole pelvis from the point at which the inferior mesenteric is tied, to the levators below, and from the ureters down on the lateral walls, is dissected as clean as possible.

The peritoneal incision is carried across the bowel at the rectovesical fold, and the bladder freed from the rectum for an inch or more. The rectum and sigmoid, with their mesenteries, are now held forward, and the peritoneum sutured behind the bowel and close about it.

If the sigmoid is to be brought through the sphincter, nothing more is done. If a colostomy is to be done, the loop of sigmoid is brought out through a rectus incision, or through a gridiron incision just above the anterior, superior spine, double clamped, and cut with the cautery, great care being used not to injure the vascular arch, at this point. The clamps are left on the bowel for twenty-four, forty-eight or seventy-two hours, depending on the comfort of the patient.

From five to seven days later, under spinal anesthesia, the second stage of the operation is carried out. The patient is put in the reversed Trendelenburg position, as used by the Mayos, a median incision is made, and the coccyx removed. If the rectum is to be amputated, the sphincter, ischiorectal fat, levators and all tissue between the ureters are freed, and the dissection carried up to the first-stage dissection. The bowel is clamped at the peritoneal floor, the vascular

10. Miles: Brit. Jour. Surg., October, 1914.

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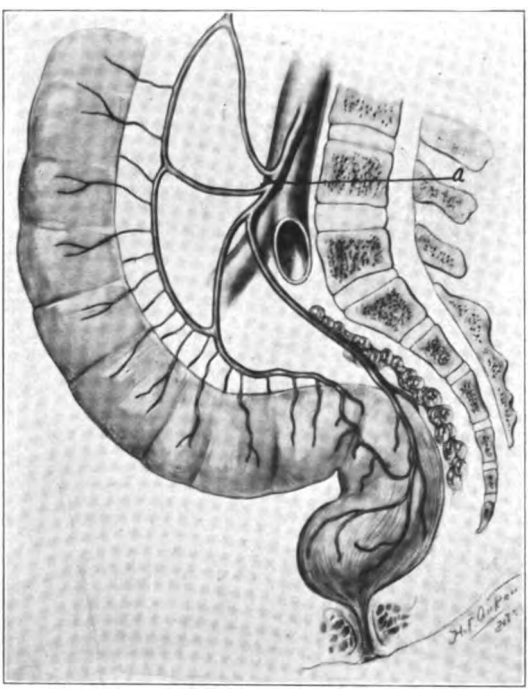

Fig. 1.—Diagrammatic sketch of the blood supply of the sigmoid and rectum through the inferior mesenteric; *a*, point at which the inferior mesenteric artery is tied.

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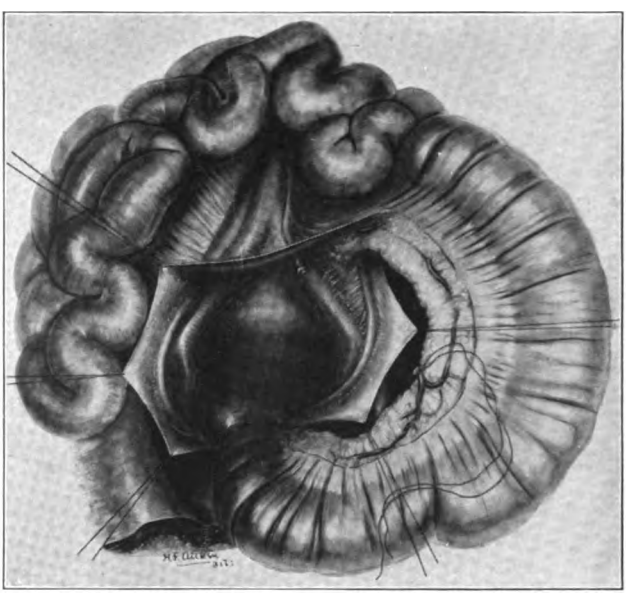

Fig. 2.—Reflection of the peritoneum from the mesentery of the sigmoid and from the rectum. Ureters pulled back with peritoneal flaps. Pelvis dissected.

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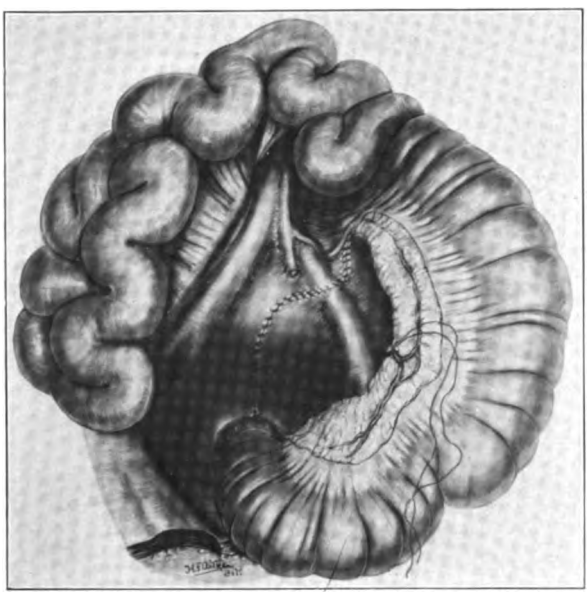

Fig. 3.—Peritoneal flaps closed over pelvis and about the rectum.

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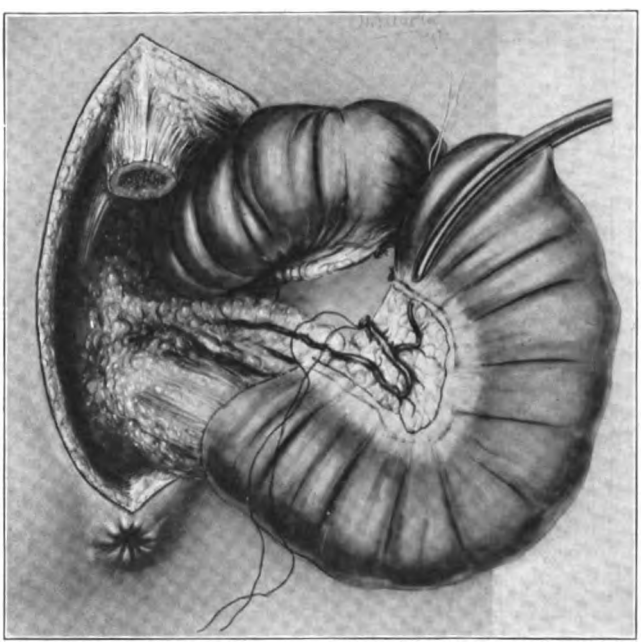

Fig. 4.—Dissection completed below for a resection of the rectum. Sigmoid tied off above with a wire and clamped below.

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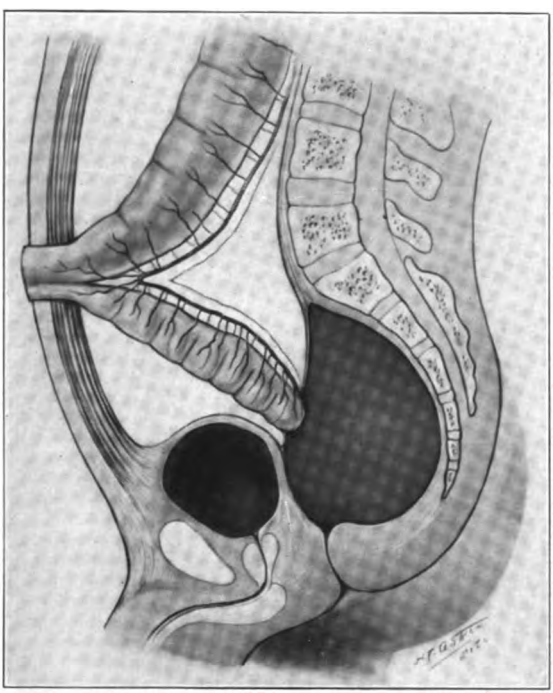

Fig. 5.—Completed second stage with amputation of the rectum.

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arch is tied, and the incision carried down through the mesentery to the incision in the mesentery made above, where the inferior mesenteric was tied. The bowel is now amputated with the cautery, the proximal end inverted, and a drain put in down to the stump.

If the sphincter is to be left, the sigmoid is pulled down and amputated at the desired point, between a wire and a clamp, with the cautery, the bowel cut off just above the sphincter, the mucous membrane dissected from the remaining bowel, and the sigmoid, closed by a wire, is pulled down through the sphincter. A large drain is put into the pelvis, to fill up the cavity left by the removal of so much tissue.

The essential points in this operation are: 1. The inferior mesenteric is tied high, and removed with the lymphatic channels accompanying it. 2. The sigmoid and rectum can be left in situ, after tying the inferior mesenteric and dissecting the pelvis, without fear of gangrene, because the vascular arches from the middle and left colic arteries are left intact to supply the bowel. 3. A thorough dissection of the pelvis is made, including most of the lateral glands, into which some of the lymphatics of the rectum drain. 4. By closing the peritoneal flaps about the intestines, the second stage of the operation is entirely extraperitoneal. 5. The effect of sepsis is much diminished. The five days between the two stages seem to be sufficient to seal the lymphatics of the pelvis, which reduces the immediate effects of the infection. Those cases which become infected show a comparatively mild course. This is of considerable importance, for, in the combined operation, there is a very large cavity left in the pelvis, after removal of the rectum, which it is almost impossible to keep clean. 6. In cases with partial obstruction, the dissection can be done before doing the colostomy, with little more effect than by doing the colostomy alone. In those cases in which it is desired to do a resection, the freeing

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up of the bowel, and then leaving it for five days, seems to diminish the obstruction, rather than to increase it. The contents will move through the section of bowel, the mesentery of which has been freed for 18 or 20 inches, fully as easily as through a normally attached bowel.

Some of the disadvantages of this operation as compared with the single-stage operation are: 1. A wide dissection is made and left exposed for five or seven days. Many lymphatics coming from the region of the growth are cut across, making it possible for cells from the growth to be deposited in the denuded pelvis. How great this danger is, I do not feel in the least certain of. One might say that if cells are running about in the lymphatics, they may as well be dropped into the denuded pelvis, as to be carried beyond into normal tissue. However, to obviate this difficulty, I have seared with the cautery as much of the surface of the mesentery as possible, to close the lymphatics. 2. Another disadvantage is the thickening and hardening of the fat, which takes place during the period of waiting, which makes an end-to-end suture somewhat more difficult. 3. The prospect of two operations is not pleasant to many; this is partially obviated by the use of spinal anesthesia for the second stage.

After using the combined abdominoperineal operation in one stage for two years, the advantages of the two-stage operation have so impressed me that I feel justified in offering this operation as one which will give the greatest satisfaction, and solve many of the problems of this difficult surgical procedure.

Perhaps one of its greatest advantages is the fact that sufficient time may be taken to do a thorough dissection of the pelvis, both above and below. That this is important, I am convinced, because metastases which I have seen have been in the glands immediately beneath the bladder, and on the lateral walls of the pelvis.

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Judging by the course of my cases, I am convinced that the mortality can be reduced to that of the Kraske operation. I say "judging by the course of my cases," for my statistics are not sufficiently good to warrant this statement from them alone. I have operated on sixteen patients by the two-stage combined operation, with three deaths, a mortality of 18 per cent. In extenuation of these figures, it may be said that no effort has been made to choose proper cases, because I was trying to convince myself as to its value. The three patients who died were all over 63 years of age. It may also be mentioned that a radical operation of some sort was done on 54 per cent. of the cases entering the hospital.

If under such circumstances we can reduce our mortality to 18 per cent., it is fair to assume that with proper selection of cases, it may be reduced to 15 per cent. or even 10 per cent.

A very important question to decide in the operation is as to whether there shall be a resection of the rectum, or an amputation. Statistics show that amputation gives a lower mortality, and a higher percentage of three-year cures. Miles of London believes, after careful investigation of recurrences of cancer of the rectum, that the only logical method is to remove the sphincter, ischiorectal fat and levators in all cases.

This I believe to be true, because of the recurrences I have seen in the last two years, in all of which there has been a local recurrence in the neighborhood of the suture, and metastases in the pelvic glands, in the immediate neighborhood. It is my firm belief that amputation of the rectum, with a permanent colostomy, is the method of choice, except in very rare instances.

Moynihan[11] and Bloodgood[12] both state that there are too many colostomies done, while it is my conviction, which is made stronger with every operation,

11. Moynihan: Surg., Gynec. and Obst., May, 1908, p. 463.
12. Bloodgood: Surg., Gynec. and Obst., 1906, iii.

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that there would be a very much lower mortality, and a much higher percentage of three-year cures, if a permanent colostomy were done in all cases.

I have tried in vain to avoid the pitfalls which seem to be present in the operation for resection, without avail, and each attempt at resection has convinced me more and more that amputation should be the operation of choice. Some of my difficulties have been: the necessity of resecting nearer the growth than is desirable; the sloughing of the distal portion of the sigmoid, which occurred in spite of the fact that the bowel had been well nourished between the first and second stage, a period of five days. In another case, an opening was made into the bowel in separating it from the prostate and urethra. The patient was fat, and the distance between the ischia was very narrow. In still another, after two weeks of apparently solid union, a sinus opened at the line of union.

In addition to these dangers, there is the added risk of infection, which must always take place to a greater or less extent in every resection. As Mayo has said that 90 per cent. of the deaths in operations for cancer of the rectum are owing to sepsis, this must be an important consideration. It is certainly a much more attractive proposition to feel that you are to leave your patient with a sphincter than without, but it must be remembered that it is impossible to be sure of a useful sphincter, in these cases. The extensive dissection, the large amount of cicatricial tissue and the disturbed sensation of the anal region are very likely to leave a sphincter which is useless, and, as has been said, "An abdominal anus is much better than an uncontrolled anus in its normal position."

A permanent colostomy no doubt has many disadvantages. Chief among them is the impossibility of getting the consent of the patient to the procedure in some cases. I cannot urge operators too strongly, however, to do in the great majority of cases the oper-

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ation which will give the patient the best chance for a permanent cure, and the lowest mortality. This, I believe, is obtained by amputation rather than resection. To quote Chalier and Perrin, resections gave 11 per cent. of three-year cures, while amputation gave 22 per cent. That there is an occasional case in which resection should be done, cannot be denied. This should not alter the rule, however, that a permanent colostomy should be done in all cases.

A word as to the treatment of inoperable cases: A colostomy, in spite of its disagreeable features, relieves most of these patients tremendously, while in some other cases, the tenesmus and constant discharge of pus and blood continues. This measure of relief is often denied patients, because it is believed the patient will live but a short time. Unfortunately, these patients live on and suffer for a much longer time than is generally counted on. Mr. Harrison-Cripps has shown that among his patients, those on whom he did a colostomy lived twenty-two months, while those without a colostomy lived 7.8 months.

It has been hoped that radium tubes, placed in the bowel in direct contact with the growth, would give some relief, but the cases treated here have thus far been disappointing. Sampson Handley reports a case, apparently inoperable, which became operable, after the use of radium, and in which the patient was well at the end of a year after operation. We may hope for some relief from this source before long.

At the present time, we have hopes that the heating of these growths, with the Percy cautery, will be of benefit in lessening the discharge and pain. In the male, we have carried out a technic similar to that of Percy for carcinoma of the uterus. The abdomen is opened, and a small opening just large enough to admit the index finger is made in the posterior wall of the bladder; one finger is put through this opening into the bladder, and the rest of the hand about the rectum to control the heat and guide the cautery.

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A Boldt water-cooled speculum is placed in the rectum, and the cautery pushed upward through the growth, until the whole growth is heated and melted away, as in the uterine growths.

We have used this method but twice, but have been very favorably impressed with the results thus far, in that the discharge has diminished, and the tenesmus has been lessened. Any improvement, however slight, seems worth while in this deplorable condition.

I cannot close this paper without emphasizing the fact that if the combined abdominosacral operation has any advantage over the posterior operations, it is so slight that it amounts to nothing compared to the advantage that would be gained if cancer of the rectum could be recognized earlier. There is a long period, I am sure, when the disease is local, and when a local or posterior operation would be sufficient to cure.

195 Beacon Street.

ABSTRACT OF DISCUSSION

ON PAPERS OF DRS. H. BEECKMAN DELATOUR AND D. F. JONES

DR. MILES F. PORTER, Fort Wayne, Ind.: A few pertinent figures will serve to emphasize the importance of this paper. More than one person in every 1,200 in the United States dies of cancer every year (Rodman: THE JOURNAL, 1908, li, 1542). In the mortality list of the United States cancer ranks sixth (*Med. Rev. of Rev.*, 1911, xvii, 166). Stierlin (*Ann. Surg.*, 1890, xi, 206) says that of all deaths from cancer 3⅛ per cent. are due to cancer of the rectum. About half of all cancers originate in the hollow viscera of the abdomen exclusive of the bladder. Mistakes in diagnosis are common. Benign conditions have been mistaken for malignant ones and vice versa by many. In the absence of microscopic examination diagnosis is sometimes impossible. And in this connection it should be remembered that some parts of a given tumor may be benign and other parts malignant, and that multiple growths may be found, some of which may be innocent and others malignant. Also the possible coexistence of syphilis, tuberculosis, and cancer should constantly be borne in mind. Possibly we may in the near future get some help in diagnosis from the serum (Abderhalden) test. Goodman and Berkowitz diagnosed 30 out of 33 cases by this method, and Cytronberg's experiments seem to confirm the correctness of the principle of the reaction

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in the dialysis method (*Am. Jour. Med. Sc.*, May, 1915, p. 761). Unfavorable results obtained from treatment are chiefly due to delay. Only about 50 per cent. of these cases are operable when they first present themselves to the surgeon, usually after two or three years' duration of the disease. Routine roentgenographic, sigmoidoscopic and digital examinations, the latter done with the patient standing, will do much to help in the diagnosis of these cases. The arrangement of the lymphatics makes metastasis slow and accounts for the relatively good operative results as pointed out by Madelung, Mayo and others. However, this arrangement of the lymphatics should not lead to less wide excisions than obtain generally in cancer, for the local spread of the disease may be quite wide, and, indeed, usually is, because most patients do not present themselves to the surgeon until two or three years after the commencement of the disease.

Kelling succeeded in producing tumors in hens by injecting into their abdominal cavities chicken embryos. He found it essential to success, however, to sensitize both the donor and the recipient. These experiments sustain the theory of Cohnheim and show that alien albumin favors the development of tumors. Hence patients after the removal of cancers should avoid raw albumin as food, and it should also be avoided by those who have conditions predisposing to cancer, and by patients with gastric and intestinal lesions, for those lesions render the alimentary wall permeable to alien albumin.

Dr. C. B. Davis, Chicago: The paper of Dr. Jones represents the accepted view of the majority of men doing any considerable amount of work in cancer of the rectum. No single procedure either low or high should be selected for all cases. It is along these lines that we have had the greatest variety of opinion in this field, one man insisting on the lower or perineal route and another on the sacral route, and others advising a combined operation. There is a feeling now that the abdomen should be opened to determine operability, the extent of the growth, and to mobilize the bowel preliminary to the work by the sacral route. Dr. Mayo summed this up well when he suggested that all operative procedures in this region should be judged from the immediate mortality, a functionating anus and the ultimate prognosis. Preservation of the anus is ideal of course, but an anus not controlled by its own nerve supply is not comparable with an anus in the abdomen. The sacral anus has been employed more frequently in the past than the abdominal anus. With the abdominal anus, if the bowel is brought down in a large loop and then brought through the abdomen, greater security and comfort are given to the patient. The abdominal anus will never be chosen voluntarily by the patient, but we should insist more often on

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the bowel being treated in this manner. The ultimate prognosis of the two types of sacral operation and the abdominal procedure have been worked out by Hartman of Paris. He showed that recurrence following operations treated by the abdominal route were 18 per cent., while recurrence in cases handled by the sacral route showed a recurrence in 68 per cent. of the cases. Thus in attempting any given case we should have constantly in mind the two alternatives, a low immediate mortality with a high percentage of recurrence, or a somewhat higher mortality with a tremendously reduced recurrence percentage.

Dr. Alexius McGlannan, Baltimore: About two years ago we studied ninety cases of cancer of the colon of which there were specimens in the laboratory. The clinical history of the cases, particularly the history of the early symptoms of the disease, was exactly in accord with the symptoms noted by Dr. Delatour. The cases were divided into two large groups having nearly the same number of cases in each. In the first group we had the symptoms of obstruction and in this series if the patient did not die as the result of the obstruction, we had good results as far as permanent cure was concerned. In the second group the prognosis was bad, as most of the patients died from the tumors. When looked into pathologically we found in the group of cases with obstruction that the tumors were cylindrical cell cancers, growing into the lumen of the intestines and with metastasis largely limited to the nearest group of lymphatic glands; while on the other hand in the fatal group of cases we found cuboid cell carcinoma, soon growing into the subperitoneal tissue of the bowel, and then early and widespread metastasis. This relation of clinical course and pathologic picture was probably the most interesting thing in the study.

Dr. Louis J. Hirschmann, Detroit: The important point regarding carcinoma of the large bowel and rectum which should be emphasized is this question of early diagnosis. Dr. Delatour spoke of care used in examining these patients. No matter if you find hemorrhoids, fistula or fissure, don't be satisfied, because often you may find a carcinoma higher up accompanying the lower minor condition. I have examined several patients after minor operations had been performed in good hospitals by competent men and carcinoma within reach of the finger was undiscovered. Always look higher up no matter how apparently simple is the case. In the diagnosis of carcinoma of the large bowel, use fluoroscopic palpation. If there is an impaction in the large bowel, fluoroscope and then palpate. Where the fluoroscope shows narrowing, irrigate and feel the spot and examine closely and a haze will be seen around the narrowing which is diagnostic of carcinoma. In resection, we have more or

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less narrowing of the lumen, usually less in good surgery, but where this exists we have some obstruction to the fecal current even in the best operation. If we will just do the same thing in a carcinoma as in intestinal stasis and short-circuit, we will reduce the operative mortality and percentage of recurrence.

Dr. Robert C. Coffey, Portland, Ore.: I am very glad nearly all agree that the two-stage operation is the one of choice and gives the best results. I have always been content to follow Dr. Mayo in this work because of his results. We have somewhat modified the technic, however, by doing the major procedure first as follows: (a) Pass a rectal tube with an eye on each side up through the rectum past the growth, and let this remain so that the sigmoid empties itself during the progress of the operation. (b) Mobilize the sigmoid and rectum down to the bottom of the culdesac, as shown in the original article published in the *Annals of Surgery*, April, 1915. Cut the intestine in two between Payr clamps. Sew up the two ends. Cut and tie the superior hemorrhoidal artery. Dissect the pelvic fat down as Dr. Jones has recommended here. Now push the rectal tube up to the end of the distal segment, pass a silk suture through the upper end of the intestine and through the two eyes of the colon tube. Swab the sutured end of the distal segment with iodin, and invert the intestine by pulling on the rectal tube until the intestine is brought out through the anus, making an intussusception. Suture the peritoneum over the raw edges and draw it over the intussuscepted end, making the growth extraperitoneal. Bring the proximal end of the sigmoid out through a stab wound, making a permanent anus through the left rectus. This gives the best results even if objected to by the patient. We now refuse to make a sacral anus, because we know it is not so good. At the next operation simply do the Kraske operation, removing the growth whole, and it is a perfectly simple operation. Our results have been much better and we have had less shock by this method than by any other method which we have tried. We have operated on nine patients by this method with one death, and we have one in the hospital now who is ready for the second operation. By doing the major portion of the operation first there seems to be less shock, in our hands, and we believe it is an improvement over other methods.

Dr. John Rawson Pennington, Chicago: In cancer of the rectum we can by proper proctoscopic examination determine conditions just as well as on the surface of the body. We cannot do it with the finger and speculum, but must use the protoscope and locate it properly. Examinations should be made of all patients over 40 years of age in order to

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detect conditions of this kind. In regard to the abdominal operation, the last speaker said that we were united in doing the two-stage operations, but I have used only the one-stage operation, and in doing this I have followed the technic advised by Miles. When doing the operation, after the abdomen is opened, with the patient in the Trendelenburg position, locate the ureter and the inferior mesenteric artery and divide the peritoneum down on either side with your hand and scoop out all lymphatics down to the coccyx and in front separate the rectum from the tissues half way down to the vagina or prostate; separate the rectum, going down to the levator ani on either side; at this junction close by purse-string suture and stitch the wound on the side and close the peritoneum over this. Close the abdominal wound and put a purse-string suture around the anus, and the operation is completed in a very few minutes. I see no reason why we should make a two-stage operation of that condition.

Dr. H. B. Delatour, Brooklyn: During the past winter I had five cases of acute intestinal obstruction due to malignant disease. This has prompted me to present to you today the paper which I have read: Three of these cases were inoperable; one had perforated bowel above the point of the cancer and general peritonitis resulted. The other two cases were sent in as appendicitis with vomiting, and in both cases it was easy to make out on examination and history that the mass was not due to appendicitis but was due to carcinoma in the colon, and resection was done with a successful result. I believe we should try to educate persons into the feeling that artificial anus is not such a terrible thing. Some say they would rather die than have an artificial anus. I believe with a properly placed anus and proper instructions given the patient as to its care, that these people can go through life with comfort. I have a patient wearing a colostomy cup and attending to business for eight years. He finds no distress due to the presence of the anus. I believe the anus should be placed in the median line rather than to one side.

Dr. D. F. Jones, Boston: I agree entirely with what Dr. Delatour has said about the artificial anus. The great difficulty at present is that we frequently have to persuade the patient to consent to a permanent colostomy, after they have been advised by the family physician not to consent to one. In regard to carcinoma of the rectum, I do not mean to convey the idea that all cases should be submitted to the two-stage combined operation, but would like to impress on you that the location of the growth has nothing whatever to do with the decision as to what operation shall be used. If the patient is over 60 years of age, the posterior operation should be done.

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TRANSVERSE INCISION IN OPERATION FOR APPENDICITIS

A. E. ROCKEY, M.D.
PORTLAND, ORE.

It is now more than eleven years since I devised and began to use the transverse incision in operations for appendicitis. My first publication was in the *Medical Record* of New York in November, 1905, in an article entitled "Transverse Incision in Abdominal Operations." Since that time I have published another paper on the method in *Northwest Medicine,* February, 1910.

Gwyllam Davis of Philadelphia, working independently, published a paper in the *Annals of Surgery* for January, 1906, describing a transverse incision operation. In the article on "Appendicitis" by J. B. Murphy in Volume Six of Keen's Surgery my operation is described in a comprehensive paragraph.

Notwithstanding these publications the method has attracted but little attention, and the vertical right rectus incision is the one in general use. I believe that the transverse incision is greatly superior to the vertical as a routine procedure. Eleven years' experience has confirmed me in this, and it is endorsed by a few who have adopted the method.

The world over it is probable that operations for appendicitis outnumber those for any other one intra-abdominal disorder. It would then seem important that a method with points of advantage, in an operation of such frequency, should have a sufficient publicity to bring it to general attention. It is for that reason that I am presenting it to this association; and also for the reason that previous descriptions have not been adequately explicit.

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Simple and easy in execution, it is not quite so easily understood as the right rectus incision. For that reason a few moments' attention to the anatomy of the abdominal wall will be necessary. In the region of McBurney's point, the fibers of the internal oblique and the transversalis run directly transverse, and the external oblique is only an aponeurosis. The aponeuroses of these muscles are united at their insertion at the border of the sheath of the rectus, the fibers of the broad tendons becoming a part of the sheath. This junction is the key to the situation in this operation.

The skin incision at the place of election is made directly transverse with its center on McBurney's point, though it may be lower if conditions require. While the favorite anatomic situation permits easy access through a short incision, which may be desirable in children, or small persons with thin abdominal walls, the incision in ordinary cases should be 2 or 2½ inches in length, and may be longer as the case requires. Continuing deeper, it passes through the outer part of the sheath of the rectus, severing the tendinous border and the aponeurosis of the muscles on a directly transverse line. When this is done, the handle of the scalpel may be inserted below, and the finger above, and the wound spread wide open by a single pull. Not a muscle fiber is cut. The fibers of the internal oblique and transversalis separate in a transverse direction. The aponeurosis of the external oblique is broader than that of the other muscles, thus permitting the incision through this to be carried further to the outer side. When the muscular part is reached, the spreading pull separates the fibers obliquely upward. The muscle is, however, as elastic as rubber, and the retractor, which is at once inserted, drawing outward, readily brings it into the transverse line. The rectus is now drawn back into its sheath at the inner side by another retractor. The peritoneum is divided on the transverse line. The

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splendid exposure which this incision gives and the ease with which it is made will surprise the surgeon who tries it for the first time.

Definite preoperative diagnosis is important. The transverse incision across McBurney's point is not adapted to pelvic operations. If doubt exists as to the differential diagnosis between the appendix and the tube, or the appendix and the gallbladder, as the site of trouble, the vertical incision is preferable. In the occasional case, when the appendix is adherent in the pelvis, a preoperative diagnosis can usually be made.

Recently I had two such cases in one day, both with acute abscess, and both correctly diagnosed before operation. One of the patients was a boy 9 years of age; the other was a man of 22. Both were operated through low right rectus incisions, treated with drainage in Fowler's position, and both made good recoveries.

In emergency the transverse incision may be readily lengthened to permit general abdominal exploration, and the performance of extensive operations. A case, which I have reported elsewhere,[1] is of sufficient interest in this connection to bear repetition. A young surgeon, who had learned and adopted my operation during his internship, had a man with a considerable mass on the right side of his abdomen, which the surgeon had diagnosed as an appendiceal abscess. He opened the abdomen by transverse incision across McBurney's point only to find that he had an extensive malignant disease of the cecum, and the adjoining descending portion of the transverse colon, with which to deal. In this emergency he covered the part with towels, continued the anesthetic lightly, and telephoned to me. I came to his assistance, and, by extending the incision on the same line, readily succeeded in resecting a part of the ileum, the cecum, and half of the

1. Rockey, A. E.: Surgery of the Colon, Northwest Med., July, 1912.

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transverse colon, making the anastomosis of the severed ileum with the stump of the colon. Primary union and a smooth convalescence followed, and the patient was not aware that anything more than an ordinary appendectomy had been done until he was ready to leave the hospital.

In interval cases or in the acute form before rupture this incision is ideal in the facility of operation and firm union with a minimum scar. Its great point of advantage, however, is in the ordinary pus case requiring drainage. The pus appendix is retrocecal or at the outer side of the cecum, in a very considerably greater proportion of cases than is realized by the operator, whose approach is from the front. In these the appendix lies directly under the line of incision. In such cases, instead of pushing the small intestine out of the way and protecting it with gauze pads it is not seen, and consequently not exposed to handling in an infected field. The advantage of such a direct approach in cases of this sort is greatly in favor of the transverse incision. Exposure of the general cavity is avoided, and drainage greatly facilitated.

When the appendix is in the iliac fossa, the finger readily separates its adhesions, and it is delivered with the cecum outside the incision. In any other situation the cecum, which presents first, is the direct guide. A few trials in pus cases will convince the surgeon of the life-saving advantage afforded by this approach, the favorable location for drainage, and the comfortable position in which the patient may be placed. Safety and comfort are favored by such a direct approach. Postoperative ileus, with its vomiting and disquieting gas pains, is minimized. The drainage track is short and direct. A single cigaret drain is placed in the outer angle of the wound posteriorly at the outer side of the cecum.

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After the operation in drainage cases the patient is placed in bed lying on the right side with the knees drawn up, and the shoulders and head gently elevated on two or three pillows. This brings the drain to the lowest point in the abdominal cavity and sufficiently elevates the diaphragm to bring it above the line of sepsis. There can be no gravity accumulation of a septic pool in the pelvis depending only on an inefficient capillary drain to take it out, as must certainly be the case in Fowler's position. The comparative comfort of the positions is all in favor of the lateral. It is the position that is most naturally sought in restful sleep. It permits considerable shifting, both of the limbs and trunk, without impairing its efficiency. Most important of all, it is a direct gravity drainage. It is a hole in the bottom of the septic pool, rather than a wick in the top. In the outward location of the drain it passes through the muscular part of the incision, permitting closure of the aponeurotic portion. This diminishes the liability to hernia in drainage cases.

Hernia will, of course, occur in a few cases when the infection is exceptionally virulent. In such cases a tissue necrosis precedes healing, and the gap thus formed may produce a hernia. The liability to hernia is less than with other incisions for the additional reason that nerve fibers are not cut and there is no muscular pull across the line of incision.

In the closure of the wound in clean cases, it will be seen that a single suture, passed deeply through the conjoined aponeurosis at the border of the rectus which I have called the "key" to the incision, will approximate the entire wound. The rectus slips back into its normal position and the transverse muscles are brought together. As a matter of safety I usually introduce two chromic sutures here and leave them untied until the remaining tissues are carefully approximated with fine continuous suture. The "key" sutures are then tied and give great strength to the closure.

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For this reason the morbidity of the operation is short, and a patient of any type may be sooner out of bed with safety than with any other method of operation.

ABSTRACT OF DISCUSSION

DR. ROBERT EMMETT FARR, Minneapolis: I can't say that I understand exactly Dr. Rockey's incision, as I have not seen his pictures. The incision which I have used, and in which I am much interested, involves the cutting of the external oblique aponeurosis if low down, or muscle if high up. The incision is made transversely and therefore cuts the external oblique fibers obliquely. This incision was described by Elliott of Boston some ten years before Dr. Rockey described it. It seems to me that it is greatly superior to the incisions of Lennander, Battle, Jalaguier and Kammerer, which divide the abdominal nerves which enter the rectus transversely. The closure of the incision is very simple, because these cut fibers of the external oblique will in all instances, in my experience, at least, submit to imbrication. Boeckman has used this incision for over ten years, and at his solicitation I began using it. I make the incision high up or low down, depending on the pathology I expect to find. The incision avoids important nerves and as Dr. Rockey has said, will drop together almost without a suture of any kind. It is closed in the same manner as the McBurney incision, excepting that the cut fibers of the external oblique may overlap. With this incision one may secure an opening reaching from the anterior superior spine to the midline. As I have been removing the appendix, at least in all of the simple cases, under local anesthesia, I feel that I have given the incision a severe trial.

DR. A. V. MOSCHOWITZ, New York: The remarks I am about to make may not be germane to the subject, because thus far at least I have had no chance to use the transverse incision in appendix operations. I have been perfectly satisfied with the McBurney or the Kammerer incision. I have used the transverse incision, however, in the upper abdomen for a number of years, and have become so satisfied with this, that I now consider it part of my normal incisions for all operations above the umbilicus. There is a principle involved in the transverse incision. One of the points I wish particularly to mention is that in gall-bladder operations and in all operations on the stomach it gives perfect exposure and is very easily sutured, and the patients have little postoperative discomfort and distress from distention, no hernia and a minimum amount of scar; the wound heals kindly. In my experience the operation is exceedingly simple; the entrance through the abdomen is a trifle more difficult because of hemorrhage, but this is coun-

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terbalanced by the ease we have with the final suture. It can be made any length. The ease of closure in particular, in spite of the drawbacks, surely warrants a more extended trial of it.

Dr. J. Chris O'Day, Portland, Ore.: Dr. Rockey saw me do a McBurney incision and asked me if I had tried his transverse incision. I said no. Dr. Rockey cannot tell you just how, but try it and when you do you will stumble into the easiest abdominal incision you have ever seen.

Dr. O. O. Witherbee, Los Angeles: To further corroborate what Dr. Rockey has given us, I wish to say that in simple cases of appendicitis it is one of the most satisfying procedures I have had the pleasure to employ. I would even like to simplify, if I could, the description he has given of the method of entering the abdomen. After the skin incision is made you need no more cutting. On reaching the muscles one little clip with the Mayo scissors in the external oblique, and then opening the scissors enlarges the incision to a sufficient extent. The same procedure is effective in the next layer and very quickly you expose the peritoneum. With forceps this is lifted up and an opening is made into the peritoneal cavity. Previous injection with novocain blocks the nerves and avoids the deep anesthesia that would otherwise be required. In the majority of cases it is not necessary to pass more than one finger into the abdominal cavity to hook up the appendix, and in a few moments your operation is completed. A single stitch is sufficient in closing the muscles. With this method one can hardly realize that he has been into and out of the abdominal cavity.

Dr. A. E. Rockey, Portland, Ore.: Dr. Farr called my attention to Dr. Elliott's having already previously used the transverse incision, but it is not mentioned in the textbooks. A French author published a description of a similar transverse incision the same year of my publication. It is evident that the natural advantages of the incision made it apparent to others. The surprising point is that there is no other incision made for the radical case. I prefer to make the incision high. There is not much advantage in making the incision down where Davis has described it, for the reason that the mesenteries of the cecum are high and not low, and when the cecum falls down lower it is not attached below except by accidental processes, so that in the great majority the cecum can be turned out, and in the best cases the drainage point is in a better location with a high incision. At this point of the aponeurosis of the external oblique it is not necessary to cut the muscle fibers at all, as when you get to the outer part in this spreading motion which I have described, with one movement the fibers of the external oblique spread forward widely.

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ROENTGEN STUDIES AFTER GASTRIC AND INTESTINAL OPERATIONS

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Through my institutional connections I have for a number of years enjoyed special advantages for the roentgenologic study of patients after gastric and intestinal operations. My colleagues have extended many much appreciated courtesies in arranging for the postoperative studies on which this paper is based. Results both good and bad have been included, the patients studied representing the work of a number of different surgeons, some of the cases coming from the most famous clinics of this country. Many of the patients had no complaint, the postoperative condition being satisfactory, at least subjectively. Others were referred for postoperative convalescence, and the opportunity was improved to make the postoperative roentgenologic observations. In the majority of the cases reported in this paper, the examination was advised in the hope that it would assist in ferreting out the cause of untoward symptoms. I would not insinuate that, because the majority of the cases included in the series studied have been unsatisfactory, referring especially to colonic operations, the majority of such cases with operation show similar late results; I merely report my findings on account of their obvious importance. The untoward results have been particularly frequent after operations for the relief of intestinal stasis, real or supposed.

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The limits of this paper will preclude a relation of the findings in more than three or four classes of cases. I have therefore decided to confine my discussion to the following: (1) acute intestinal obstruction; (2) gastro-enterostomy; (3) appendectomy; (4) ileo-colostomy, without and with colectomy. Lack of space forbids a detailed description of the many interesting cases, the details of which I hope to publish at some future time.

ACUTE SMALL BOWEL OBSTRUCTION

Our experience during the last five years has convinced us of the value of the Roentgen examination in the diagnosis of postoperative acute small bowel obstruction, with special reference to the decision as to the advisability of surgical interference. Having accumulated the evidences in a sufficient number of cases of suspected obstruction following operation, it has seemed warranted to urge strongly the value of the Roentgen study in all such suspected cases with special reference to the existence of an obstruction, the degree of the hindrance, the location and perhaps the nature of the lesion, and whether or not the obstruction is progressive. If nonsurgical treatment seems preferable at first, the progress of the case under treatment may be observed roentgenologically.

Emphasis should be laid on the fact that it is not necessary to administer any barium or other opaque material in pursuing these studies, the observations being made possible by the gas distention of the intestine. There is, therefore, no delay incurred; and no objection can be raised to the Roentgen study of these patients on account of possible danger through delay or through the introduction of new food material into the digestive tube in the presence of possible obstruction. A Roentgen study should be required in every case of suspected post operative obstruction.

Given a patient on the third day after operation, presenting symptoms suggestive of acute intestinal

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obstruction, he should be transferred to a carrier, conveyed to the Roentgen-ray department, a 14 by 17 inch plate with intensifying screen placed under him, and a flash exposure made. It must be short enough so that the patient can hold the breath during the exposure. The plate is then removed and the patient returned to his room and bed without further manipulation or inconvenience than is required to lift him onto the stretcher and back to bed again. No preparation of any kind is required; dressings are not removed. The plate is then developed and the findings may be noted as soon as it is taken from the fixing bath. Not more than twenty minutes need be consumed in the entire process.

The developed roentgenograms will reveal at once whether there is any gas distention of the bowel, and if so, whether the distention occurs in the small or in the large intestine. Acute postoperative dilatation of the stomach may be at once ruled out. Small and large bowel may be distinguished by the characteristic outlines of the gas areas. In acute colonic obstruction, the haustral markings as well as the peripheral distribution of the gas along the course of the colon are sufficiently characteristic to identify the large bowel. Equally characteristic is the appearance of the gas-distended coils in acute obstruction of the small bowel; the coils are more or less parallel and the caliber of the small intestine is increased to 1½ or 2, and sometimes 3 inches. It is seen that the distention is not confined to a short segment of the intestine but involves one or more feet of the small bowel, usually many feet. A certain amount of postoperative distention of the small bowel is frequently noted where there are no symptoms suggestive of obstruction, but in the serious cases the degree of distention is at once apparent and suggestive. The serrated contour of the bowel is characteristically different from the contour of the colon due to the markings of the haustra coli; so that we are at once able to recognize and differen-

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tiate acute postoperative gastric dilatation and obstruction in the large or small intestine.

Observation of the cecal region is especially helpful, for if the cecum contains gas, it is not likely that the obstruction is in the small bowel. If the gas collections, as above described, are seen to occupy the middle of the abdominal shadow while the flanks are gas free, it is probable that the obstruction is in the lower ileum, though not so low as the ileocecal region. When the gas areas occupy the true pelvis and the middle of the abdominal shadow, one may suspect the ileocecal region. Intussusception may be discovered by colonic injection with an opaque material. Early physical findings in these cases are very difficult to demonstrate with surety, whereas the roentgenologic findings may be demonstrated much earlier, and gain in surety as the gas distention progresses.

If the observation of the gas-filled bowel (without the ingestion of barium) does not make clear the location of the obstruction, time will be saved by proceeding at once to the administration of the barium enema to rule out colonic obstruction. If the entire colon fills, it is then recognized that the obstruction must exist in the small bowel. If the findings thus far are still indecisive, and the clinical symptoms are not yet clear, with the permission of the surgeon a small amount of barium sulphate, say half an ounce, may be administered by mouth in any medium which the patient will take. These cases are usually also so doubtful from the clinical standpoint that final decision as to operation is postponed in any case, and there is ample time for some of the barium to pass on into the small intestine. After a little experience, however, it is quite unnecessary to administer any barium at all by mouth, the decision being rendered on the appearance of the abdominal shadow with reference to the character and distribution of the gas areas which it may present.

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GASTRO-ENTEROSTOMY

To Cannon belongs the credit for some of the earliest Roentgen studies on gastro-enterostomized patients. Until a few years ago gastro-enterostomy was looked on as a drainage operation, and it was the effort of surgeons to make the anastomosis as near as possible to the lowest point of the stomach. This idea was based on the conception of the stomach as a passive reservoir from which food was discharged more or less under the influence of gravity. Cannon's studies on the movement of food after gastro-enterostomy were very carefully carried out and constitute a classic to which no exceptions can be taken.

In our studies following gastro-enterostomy, it is seen that we deal with at least three classes of patients. The first class includes those in whom the gastro-enterostomy opening is very large and the food does seem to drop in a passive way from the stomach or into the small bowel. These patients frequently complain of a sickening distress, especially after the ingestion of a meal consisting largely of warm liquid. I have attributed this distress to the sudden overdistention of the small bowel resulting from the quick clearance of the stomach through the large stoma.

In the second class fall those patients in whom the stomach does not empty well following the operation. The opening is probably not too small, but it is apparently placed too high or too far from the pylorus. The stomach empties quickly until the level of the opening is reached, after which it empties very slowly, the residue at that time remaining for eight, ten or more hours.

The normally functioning cases form the third class—those patients in whom the passage of material from the stomach occurs very much as in the normal patient. A few moments elapse before food is seen in the jejunum, the passage of food boluses is irregularly intermittent, and the total time required for

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clearance of the opaque meal averages from four and a half to six hours. Unless the operative procedure has been done for the relief of organic pyloric obstruction, it is the rule to find some of the barium passing through the pylorus. The nearer the new stoma to the pylorus and the greater curvature, the smaller is the proportion of material seen passing through the pylorus by the old route.

The only occlusion operations which were successful for more than a few weeks in preventing the passage of food through the pylorus involved considerably more than mere ligatures. In several cases in which pyloric occlusion was attempted by a tight chromic catgut ligature reinforced by linen and four to eight mattress sutures of linen to produce reduplication of the gastric wall over the ligature, examination with the barium meal showed patency of the pylorus as early as the fifth or sixth week.

Sometimes the gastric delay in the unsuccessful cases occurs in the duodenum and in the few inches of jejunum proximal to the anastomosis. Occasionally one sees a marked dilatation of the duodenum, with vigorous onward and retrograde peristalsis, the food surging backward and forward in the duodenum in a manner characteristic of duodenal obstruction. Vicious circles are sometimes encountered, and valve-like obstructions in the jejunum in the neighborhood of the operation. These have been fully described by Cannon and many others, and verified in the experience of every roentgenologist.

There are, however, two new points to which I should like to direct attention. It will be recalled that Cannon and Blake from their experimental work concluded that the stoma should be fairly large and near the pylorus—that conditions which stretch the stomach should be avoided, and that several centimeters of distal intestine should be attached to the stomach to prevent kinking in the jejunum. But when pyloroplasty was possible, these authors thought it was the

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operation of choice. They found that the rapid exit of food from the stomach was prevented by the formation of rhythmically contracting constriction rings in the duodenum. They believed that this activity replaced in part the function of the pylorus and also served to mix the food with the pancreatic juice and the bile. I have observed this phenomenon in two out of four cases in which a Finney operation had been done. It is interesting that analogous phenomena were noted in a large number of cases in which the ordinary gastrojejunostomy had been performed, namely, a sort of sphincter action established in the jejunum at a point varying from 3 to 6 cm. below the gastrojejunal opening. This was at first interpreted as a spastic contraction of the circular muscle of the jejunum; but in the light of Cannon's observation on rhythmic contractions of the duodenum after pyloroplasty, it seems reasonable to conclude that this contraction ring in the jejunum is purposive, serving somewhat as a sphincter.

Kocher years ago made the statement that the gastro-enterostomy opening developed a sphincter action and actually underwent rhythmic contractions. It seems possible that the formation of a contraction ring in the jejunum below the site of operation may well simulate the normal action of the pyloric sphincter. Under the fluorescent screen, one sees a small fingerlike shadow gradually build down behind the gastric silhouette, simulating very much the formation of pseudopodia in the ameba. This fingerlike shadow projects farther and farther until it is suddenly constricted off an inch or two below the stomach, the pinched-off bolus passing onward into the distal small bowel, the proximal portion remaining and gradually assuming larger proportions until the distal portion of it is again pinched off by succeeding contractions. In other words, this action has in a certain degree seemed to take the place of the rhythmic contraction normally occurring at the pylorus.

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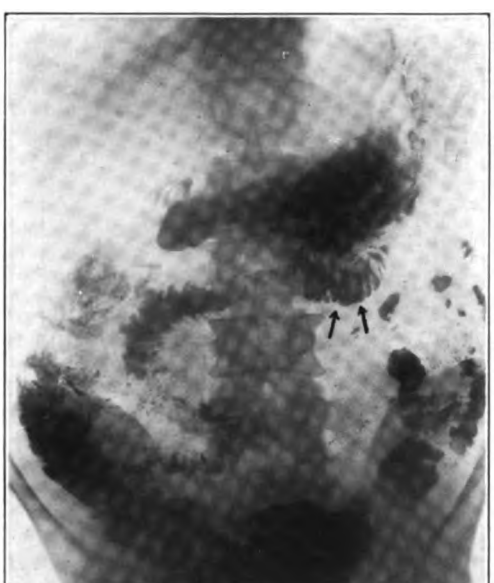

Fig. 1.—Gastro-enterostomized stomach, five hours after eating. Note the delay in the jejunum opposite the stoma. After complete clearance of the stomach, this residue in the jejunum persisted for several hours. This case is typical of the findings in a large percentage of gastro-jejunostomies.

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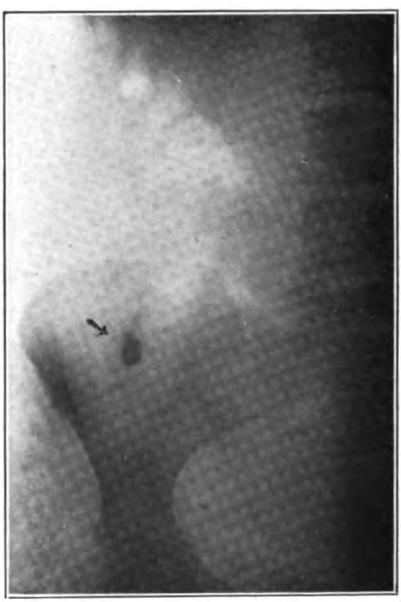

Fig. 2.—The small rounded residue often seen at the site of the appendix stump following appendectomy; also sometimes seen about the base of a diseased appendix before removal. In some of the cases showing such a residue after the barium meal, the operation had been performed years before.

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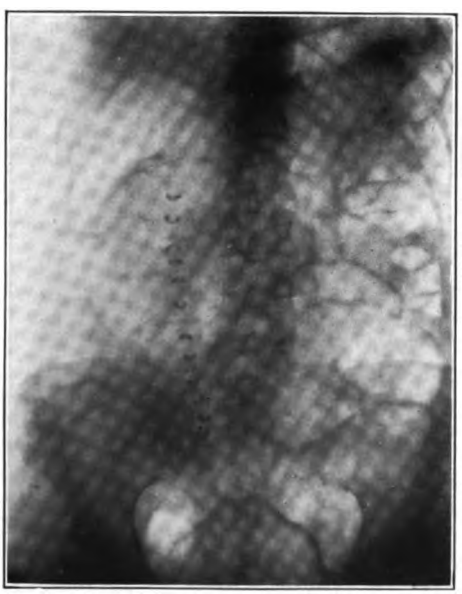

Fig. 3.—Very marked distention of the colon with gas in a case thought to be acute small intestinal obstruction. The gas distention was relieved by washing out the colon, and the administration of pituitary extract. The distribution of the gas and the characteristic markings of the bowel outlines indicate colon rather than small bowel.

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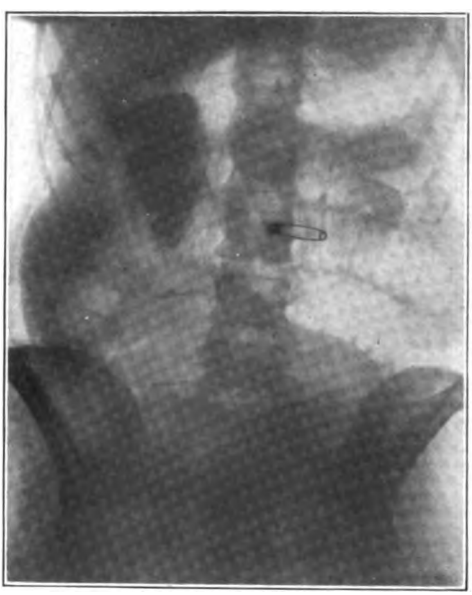

Fig. 4.—Acute obstruction high up in the small intestine, somewhere near the junction of the jejunum and the ileum. Note the absence of gas-distended coils in the lower half of the abdominal shadow.

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Fig. 5.—Marked gastric dilatation. Acute obstruction low in the small bowel, yet a little distance above the ileocolic junction. One determines this by the distribution of the gas-distended coils. The trace of barium in the cecum remained there from a preoperative barium meal study.

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Fig. 6.—Very high grade of acute obstruction near the ileocolic junction. The dilatation of the entire small bowel in this case was extreme.

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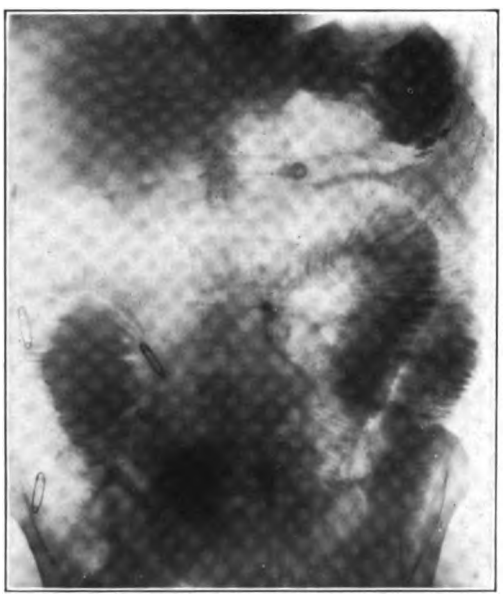

Fig. 7.—Acute obstruction in the small intestine in which the decision to operate was not made until the second examination, six hours after the first. Meanwhile a small amount of barium had been given, and the characteristic appearance of the small bowel visualized.

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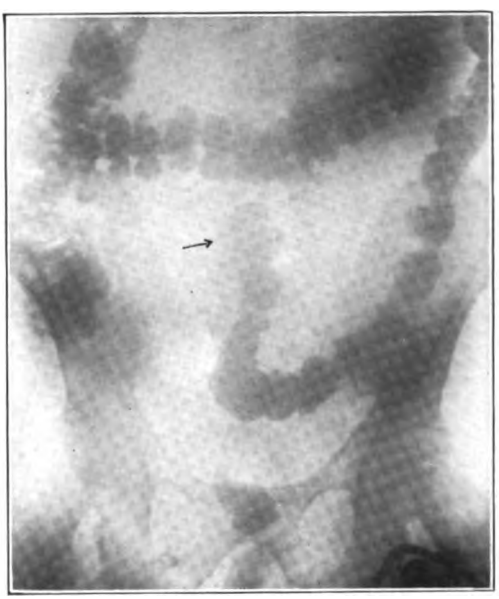

Fig. 8.—Three years after ileosigmoidostomy. The arrow indicates the site of the anastomosis. Appearance of the colon forty-eight hours after barium meal. The colon is filled by material carried backward from the rectum by retrograde peristalsis. This retrogression of food residues often forms large cecal tumors.

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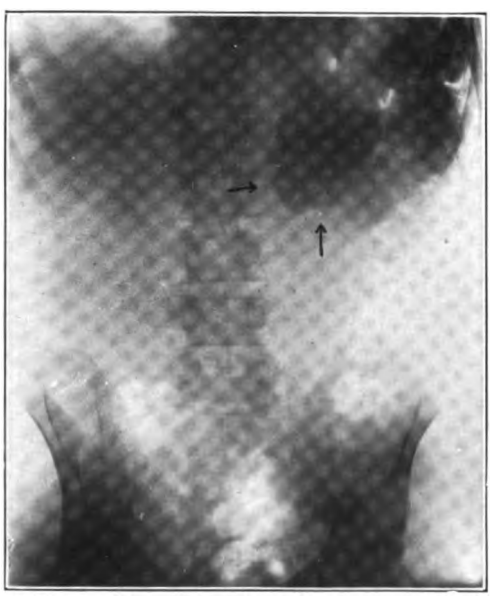

Fig. 9.—Even after removal of the right half of the colon, including the first third or half of the transverse colon, there is a tendency to the formation of a tumor in the proximal end of the remaining large intestine. In this case the barium-mixed residues in the stump are shown on the ninth day following the meal, forming an easily palpable tumor.

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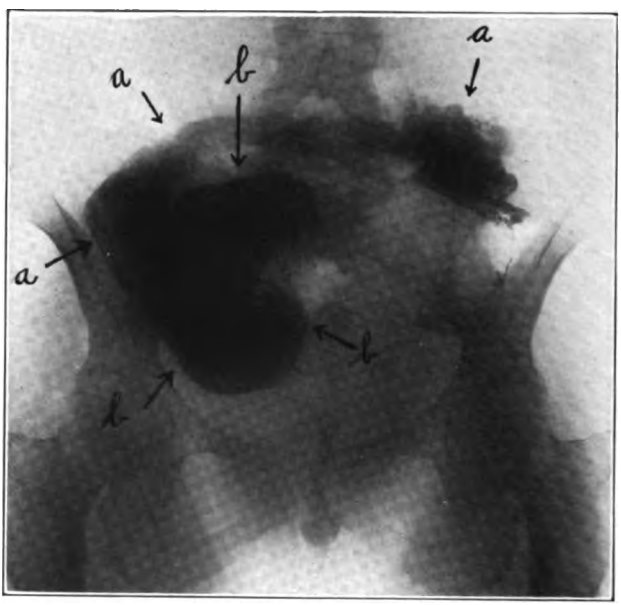

Fig. 10.—This backing up into the short-circuited colon takes place constantly, and begins immediately after food reaches the rectum. This roentgenogram, twenty-six hours after eating, shows at *a* the backed-up material in the transverse colon and cecum, and at *b* a large residue still remaining in the terminal ileum. The bowels had meanwhile moved satisfactorily (?) several times. (See Figure 11.)

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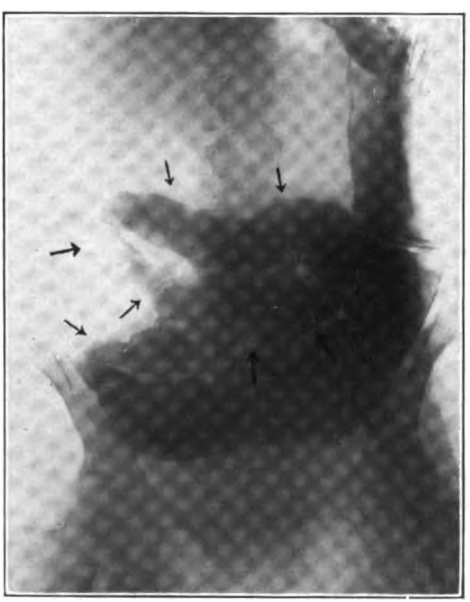

Fig. 11.—(See Figure 10.) The very marked distention of the coils of terminal ileum attending the marked ileal stasis in some of these cases is illustrated by the colon injection . Same case as in Figure 10. The arrows point to distended small bowel, the seat of stasis in Figure 10.

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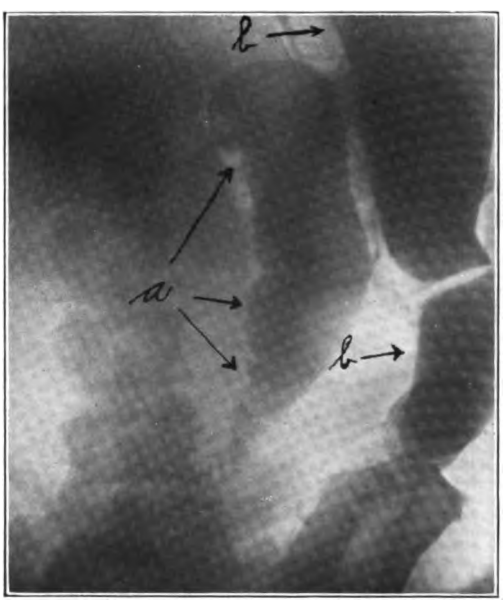

Fig. 12.—Another case two years after ileosigmoidostomy. Colon injection. Note the very marked dilatation of the small bowel shown at *a*, whose caliber equals that of the neighboring colon shown at *b*. There was marked ileal stasis in this case, shown after the barium meal. In cases of ileosigmoidostomy examined shortly after the operation, there is noted a similar insufficiency of the ileocolic orifice, but the coils of terminal ileum do not exhibit the same degree of dilatation until later.

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Fig. 13.—In performing the operation of ileosigmoidostomy, it is possible to make an artificial valve at the new opening, by Kellogg's method. In the case here figured, the right half of the colon had been removed, the ileum being inserted into the sigmoid with the formation of an artificial valve. The enema failed to enter the ileum. There was no ileal stasis following the meal. There was marked stasis in the blind portion of the remaining colon; *a*, stump of transverse colon; *b*, site of ileocolic junction.

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A second new point relates to a stagnation of food in the jejunum at or near the site of the gastro-enterostomy. Cannon, with F. T. Murphy, made intestinal resections in animals, uniting the severed intestine either by end-to-end or by lateral anastomosis. After lateral anastomosis, there occurred a more or less complete blocking of the canal by undigested detritus at the opening between the opposite loops. Necropsies on animals proved that the stasis was not due to previous accumulation of undigestible waste, but that the two apposed coils did not cooperate to propel the enclosed food, and that after an ordinary meal, food was stagnant in the region of the anastomosis. It has seemed to me that the same phenomenon is also observed after gastro-enterostomy. Especially toward the end of gastric clearance, there occurs a stagnation, apparently in the small bowel, at the site of the anastomosis, this stasis being accounted for by the inhibition of onward peristaltic activities at this point (Fig. 1).

APPENDECTOMY

A common cause of cecal stasis is adhesions, usually associated with disease of the appendix. It is also a fact that immediately following recovery from the operation of appendectomy, there is in the majority of cases a considerable degree of cecal stasis. The cecum retains portions of the barium meal for from two to four days, and sometimes more, although the remainder of the colon may clear itself normally. Following the attempt to expel the barium enema it is seen that the cecum has failed to contract, the propulsive ring peristaltic waves which evacuate the large bowel commencing at or above the ileocolic junction instead of at the tip of the cecum. Even at a remote period after the operation, several years later, a certain degree of cecal stasis persists in a considerable number of cases, a rounded residue of barium the size of a 25-cent piece remaining in the cecum after the colon has otherwise been entirely cleared of the

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barium meal. This is especially likely to occur where the patient complains of a tenderness over the cecum. Sometimes this cecal stasis was present before the operation, as shown by the preoperative Roentgen records; but that it often exists after operation where it did not exist before is convincingly shown by our series. I believe that the rounded barium residue, above referred to, occurs at the site of the stump of the appendix, and that it has some relation to the invaginating suture by which in the technic commonly employed the stump is buried. The coincidence of a point of localized tenderness on pressure with this rounded residue at the site of the appendix stump would suggest the desirability of including the least possible amount of cecal muscularis in the invaginating suture.

In a few cases in which it was thought that the appendix had been removed, a characteristic shadow was noted in the appendical region, resembling the appendix. In three of the four cases of this sort which went to operation a second time, there was found a definite, uninvaginated stump of appendix, the residue measuring more than 2 cm. in length in one instance. In the fourth case the operation revealed no abnormality in the cecum. In fact, it was difficult to decide just where the appendix had been removed.

ILEOCOLOSTOMY

I have been especially fortunate in having been able to study a large series of cases after ileocolostomy performed for adhesions, ileal stasis, Lane's kink of the ileum, and other nonmalignant lesions. Forty such cases have been examined very carefully, operation in most of them having been performed according to the technic advocated by Lane, one of them by Lane himself. Not all the patients in this series were clinically failures, though the majority of them were examined for the cause of an unsatisfactory result. In most of them, during the early months following

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operation, the result was apparently worth while, and in a few striking instances the operation had seemed to work like magic; but sooner or later, usually within a year after the surgical procedure, the symptoms have begun to recur and the patient's last state is worse than the first. It should be remembered that this series of cases represents the work of more than a dozen different surgeons, most of them of national reputation—work which I believe to be on the whole representative of the best in technic which this country affords. The unsatisfactory results can, therefore, hardly be attributed to poor technic.

Excepting only those cases in which an artificial ileocolic valve has been formed, all cases have shown incompetency of the ileocolic stoma permitting the enema to flow back into the small bowel as well as retrogradely around the colon to the cecum or as far as the stump of the colon in those cases in which partial colectomy had been performed. The small bowel thus visualized has displayed a variable caliber, not much enlarged in the recent cases, but frequently so large as to be confused with the colon itself in patients examined two or three years after the operation. In some of the roentgenograms it is impossible to tell definitely from the roentgenogram alone which shadows are colonic and which are ileac. Of course, it is recognized that the test by enema reverses the usual order of progress of the food column, but there is also noted in many of these cases a regurgitation of *ingested* food. There is a very definite ileal stasis in most of the older patients (operation performed a year or more before the examination). It is not uncommon to find at the twenty-sixth hour a large mass in the terminal ileum simulating a colonic residue in size and caliber of the coils. The worst cases of ileal stasis, judged by the retention in the ileum of a mass of ingesta, are those cases which, when tested by the enema, show the greatest ileal dilatation and the most extensive ileal filling by the passage of the

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enema through the anastomotic opening. This incompetency of the stoma to enema and the ileal stasis should both be prevented by the formation of an artificial ileocolic valve by Kellogg's method. In one case reexamined three years after the operation just referred to, the artificial valve still prevented the reflux of the enema, and there was no ileal stasis.

Following the barium meal, there has been noted in every case, without exception, retrograde peristalsis carrying barium oralward as far as possible from the rectum. This regurgitation commences immediately after food reaches the rectum, and the head of the backed-up column has usually reached the splenic flexure by the tenth or twelfth hour. This retrograde movement of ingested material persists in spite of repeated enemas and in spite of repeated bowel movements, so that by the end of the twenty-sixth or even the fiftieth hour, the residues are banked up in the proximal colon, from which it is very difficult to dislodge them. I have seen a large barium-mixed mass in the cecum on the fourteenth day forming a tumor in the right inguinal region, easily palpable and visible on inspection of the abdomen. Hauchamps has recently reported a case of a nervous woman of 26 years, who had suffered all her life from obstinate constipation. To give relief some surgeon made an appendicostomy, to facilitate colonic lavage. Later the patient was reoperated, the appendix being removed and the right kidney being anchored. Still later, the patient failing to improve, ileosigmoidostomy was performed. A month after the last operation the patient was given a barium meal. There occurred evident retrograde peristalsis with the formation of a large barium-mixed fecal mass in the right inguinal region, which was still visible both on inspection of the abdomen and roentgenologically on the thirtieth day, although no opaque salt had been administered meanwhile. This stasis in the excluded colon is usually attended by the formation of distressing amounts of gas, which

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sometimes distend the colon to enormous proportions, resisting all efforts to dislodge it. Gas distention of the colon after ileosigmoidostomy often distorts the stomach in such a way as to produce a pseudohourglass appearance. Efforts to prevent the retrograde procession by making a kink in the sigmoid just proximal to the anastomosis result only in greater stasis and greater difficulty in dislodging the stagnant material, which is only slightly delayed in its regurgitation.

It thus appears that in a very considerable percentage of cases in which the operation of ileosigmoidostomy is performed for the relief of intestinal stasis, particularly ileal stasis, the end-result is infinitely worse than if the patient had not been operated on, at least so far as the ileal stasis and the patient's comfort are concerned. As before suggested, there is often a period of improvement, sometimes marked; but ultimately the majority of the patients under our observation exhibit a recurrence of the stasis.

To avoid a recurrence of the ileal stasis, Kellogg has endeavored to make an artificial ileocolic valve, hoping to prevent the regurgitation of food residues back into the ileum and to lessen the ileal delay. This operation, which results in the formation of a valve-like invagination of the terminal ileum into the colon in a manner resembling the formation of the normal ileocolic valve of the pig, is accomplished by a modification of the ordinary technic for end-to-side ileosigmoidostomy. In twelve cases the valve thus formed has worked satisfactorily in seven, the five failures occurring early in the series. Even in those cases in which the effort to make an artificial valve failed, the patient was no worse off than if the ordinary anastomosis had been performed. When ileocolostomy must be performed, it seems distinctly worth while to attempt the production of an artificial one-way valve, simulating the normal ileocolic junction.

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To obviate the retrogression of rectal contents back into the excluded colon in these cases of ileosigmoidostomy, a number of surgeons conceived the idea of resecting the right half of the colon, including the cecum, the ascending colon and a part of the transverse colon. This operation preserved the omentum and saved the patient much of the shock likely to attend removal of the colon down to the sigmoid. In all the cases thus operated in which the patients have come to me for postoperative study, there has been demonstrated the same retrogression of colonic contents with the formation of an obstinate residue in the blind end of the stump of colon, this residue in several cases forming a palpable and visible tumor, persisting many days. In one case this tumor persisted longer than nine days, in spite of repeated daily enemas and the use of laxatives. The severity of the stasis in the stump of the colon has a relation to the length of time which has elapsed since the performance of the operation, becoming progressively worse as the months go by.

The operation of cecosigmoidostomy was also proposed as a procedure which would obviate the distresses attending the retrogression of materials up the colon under the influence of antiperistalsis. This operation appears to me an illogical and unreasonable procedure in these cases. In one instance in which it has been impossible to secure a reexamination by means of the Roentgen ray, the reports from the patient are fairly satisfactory; but in the other cases examined at some interval after the operation (three cases), there has been seen a double procession of food residues, one column traveling up the ascending colon in the normal direction and the other up the descending colon, the two columns tending to meet near the middle of the transverse colon. My friend, Dr. L. T. LeWald, who has studied such a patient two years after operation, has kindly communicated to me his Roentgen findings:

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The intra-abdominal distress and the constipation were relieved for a time, but the symptoms recurred within two years and the constipation became extreme. The bowels never moved without enema, and the gas distention of the abdomen was very distressing. Roentgen studies after a barium meal showed most of the meal going in the direction of the hepatic flexure and transverse colon instead of through the cecosigmoidostomy opening. At the end of twenty-four hours the transverse colon was filled, only a little having passed from the cecum through the artificial opening. By the end of the second day only a trace of the meal had been eliminated, the greater part remaining in the cecum, ascending colon and the transverse colon. Seventy-two hours after the meal and after repeated enemas, it appeared that the elimination of the barium-mixed residue was almost impossible, the appearance suggesting a definite vicious circle. As some of the barium passed down the descending colon and began to enter the sigmoid, it appeared to enter the cecosigmoidostomy opening into the cecum, and thence through the ascending colon back into the transverse colon. Only a small portion remained in the rectum and was voided.

The next class of cases includes those in which it was not deemed advisable to subject the patient to an extensive colectomy, and yet radical treatment was demanded. It was finally decided to make an ileocolostomy with partial colectomy, that is, resection of the right half of the colon followed by insertion of the ileum into the transverse colon as near as possible to the stump. In our Roentgen studies as well as in our clinical observations in these cases, this type of operation has given the most satisfactory results. Thus far, it would appear, both clinically and from the Roentgen findings, that this type of operation is preferable where any operative procedure at all seems indicated for stasis in the right half of the colon. Of course, for a lesion in the pelvic colon such an operation would not be likely to afford any improvement of the condition.

It would thus seem that when for any reason it appears necessary to resect a portion of the colon, making a new ileocolic junction, the ileum should be implanted as near as possible to the proximal end of the remaining portion of the colon, and an effort

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should be made to produce an artificial ileocolic valve. Exclusion operations are invariably followed by stasis in the excluded intestine, and blind ends, as after ileosigmoidostomy with or without partial colectomy, always sooner or later become the seat of stasis, usually with the formation of distressing amounts of gas which cannot be dislodged without great difficulty. The production of a serviceable artificial ileocolic valve by Kellogg's method is quite feasible, and in the majority of cases it is successful.

I have omitted reference to postoperative findings after repair of the ileocecal valve, or after operation for suspension of the pelvic colon after the relief of adhesions, or after various exclusion operations, feeling that the space at my command does not warrant a discussion of this important group of cases. I hope at some future time to detail my findings in these patients.

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THE SUPRARENAL GLAND IN SHOCK*

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MINNEAPOLIS

The term "shock" usually brings to our minds a certain clinical syndrome consisting of mental apathy, reduced sensibility, vasomotor disturbance, weakness, pallor, subnormal temperature, rapid and thready pulse, and irregular respiration. Such a picture may be present in the severely burned individual, in the victim of a perforating ulcer, in the mangled railroad man, or in sepsis. Aside from these specific instances, we rarely see every symptom of the syndrome so exaggerated. In a broader sense we may still have shock, although some, or all, of the symptoms are mitigated or almost abated. For instance, during laparotomy the intestines in early shock lose their normal tone before blood pressure begins to fall. Persistent trauma may bring out the picture. It may be going too far to say that we may have shock without any symptoms, but it is very difficult often to tell when we get our first symptoms. To illustrate: We start to produce shock by the handling of the viscera of an animal; the first fifteen minutes of trauma produce no symptoms of shock; neither do the second fifteen minutes produce recognizable shock; but if this process is continued for several hours we finally produce the syndrome. Yet in doing this, the operator realizes that he is in some way dealing with a progressive affair.

The factors contributing to this syndrome are not easily recognized. Many authors attempt to explain

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shock on some one hypothesis. From the fact that none of the explanations clear all the phenomena, one is justified in believing shock to be composite depending on a number of variable factors. One of the factors that enters prominently into the composite of many forms of shock is concentration of the blood. Cobbett and Roy,[1] and to a lesser degree Sherrington,[2] have attempted to explain shock on the hypothesis of oligemia. This factor, important in itself, must be supplemented by other factors to make a universal application possible. The work of Henderson,[3] showing a loss of venous tone, attributed by him to deficient carbon dioxid, a damming up of the venous blood and an extravasation of the blood into the tissues is but stating the converse of Cobbett's explanation. Even when we combine the explanation of Meltzer[4] with these teachings we cannot get a full explanation of shock. I have often been impressed with the sudden collapse of an animal not well advanced in shock on the pinching afferent vagus areas in the peritoneum. This on our blood tracing revealed a sudden fall of blood pressure with cardiac slowing, exactly as obtains with vagus inhibition. Moreover, the effect can be annulled by cutting the vagi, or by atropin. Therefore, vagus inhibition seems an accessory shock factor.

Crile[5] and Dolly[6] explain shock through changes in the central nervous system with associated remote phenomena. In other words, the brain is a great storage battery in the kinetic system driving the suprarenals, the muscles, and through its action on the suprarenals the other important viscera. According to Crile, the suprarenals influence the direction of the blood supply, control the output of glycogen from the liver, inhibit intestinal function, and avert the blood from the

1. Cobbett and Roy: Quoted by Short.
2. Sherrington and Copeman: Jour. Physiol., 1893, xiv, 52.
3. Henderson: Am. Jour. Physiol., xxi, 126; ibid., 1909, xxiii, 345; 1909, xxiv, 66; xxv, 385; xxvi, 260.
4. Meltzer, S. J.: The Nature of Shock, Arch. Int. Med., July, 1908, p. 571.
5. Crile: Lancet, London, July 5, 1913.
6. Dolly: Jour. Med. Research, 1909, xxi, 95; ibid, 1910, xxii, 331.

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viscera to the more insistent organs. As evidence of the central origin of shock, Crile shows work and exhaustion phenomena in ganglion cells. These are manifested by altered Nissl substance. This offers an ingenious explanation of many of the symptoms of shock, but does not seem to lend itself readily to laboratory demonstrations. Crile teaches that the liver overcomes acidosis.

That shock is in any way cardiac, or due to cardiac failure, as advanced by Boise,[7] does not seem even reasonable. In advanced shock the heart is still capable of pumping against an enormous resistance, as can be demonstrated by the injection of epinephrin.

Acidosis[8] is considered a shock factor. By the term "acidosis" I understand is meant retention of excessive amounts of some of the beta-oxybutyric acid derivatives by the tissues.[9] Such an accumulation, when no longer neutralized by ammonium or sodium compounds of the body fluids, may lead to clinical acidosis. In traumatic shock I have never been able to demonstrate any increase of ammonia in the urine such as should occur in beginning acidosis. Dr. McClendon by accurate hydrogen ion determinations could show no increase of hydrogen ion concentration in the blood in our cases of experimental traumatic shock. In obstructive jaundice, one of my students (Olga Hansen) has produced acidosis, and this has been confirmed by McClendon's blood examination. Crile produced marked acidosis by extirpation of the liver or of both suprarenals. Clinically, acidosis is important, and may be intensified by operative procedure. However, the relation to shock is not clear.

Last of all, I wish to introduce primary suprarenal exhaustion as a shock factor. Before discussing suprarenal depletion, I will review the action of epinephrin, the product of the medullary suprarenal.

7. Boise: Am. Jour. Obst., 1907, lv, 1.
8. Crile: Ann. Surg., January, 1915, p. 6; Canad. Med. Assn. Jour., January, 1915.
9. Levy, Magnus: Bull. Johns Hopkins Hosp., 1911, xxii, 239.

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The amount of epinephrin in the blood of a normal individual is very slight, somewhere between one part in two hundred millions, as determined by Hoskins,[10] and one part in ten millions, as determined by Waterman and Smit.[11] Further than this, the epinephrin output per minute per kilogram of dog cannot be above 0.2 c.c. of a 1 : 1,000,000 solution of epinephrin. The smallest amount of epinephrin that will have any effect on the blood pressure of a normal dog is 0.42 c.c. of the same solution. This amount produces not a rise but a fall of blood pressure, and the amount necessary to produce a rise is several times as much. These facts indicate that in the normal individual, just enough epinephrin is in circulation to maintain the tone of the "myoneural junction," as the pegs of a violin maintain the tension of the strings. Therefore, we have no right to say that the normal blood pressure is maintained by epinephrin in the blood, but rather that epinephrin sensitizes unstriped muscles of the vasomotor system to the sympathetics.[12] In addition, epinephrin has other functions than that of blood pressure control. Small doses relax the muscles of the alimentary canal, and at the same time close the sphincters; cause the bronchioles to dilate, and increase secretion of glands. According to Boinet,[13] Cannon and Nice,[14] epinephrin relieves fatigued muscles. Cannon[15] emphasizes the mobilizing power of epinephrin on sugar, the rôle of this sugar as an emergency food, and in addition the effect of the epinephrin on the coagulation of blood. Emergencies may call large amounts of epinephrin from the suprarenals to the circulation. Such forced output[15] of epinephrin produces a general rise of blood pressure, shifting the blood from the less insistent abdominal viscera to organs immediately essential to

10. Hoskins, R. G., and McClure, C. W.: The Adrenal Glands and Blood Pressure, Arch. Int. Med., October, 1912, p. 343.
11. Waterman and Smit: Arch. f. d. ges. Physiol., 1908, cxxiv, 198.
12. Elliott, T. R.: Brit. Med. Jour., June 27, 1914, p. 1393.
13. Boinet: Compt. rend. Soc. de biol., 1895, xlvii, 273.
14. Cannon and Nice: Am. Jour. Physiol., 1913, xxxiii, 44.
15. Cannon: Am. Jour. Physiol., 1913, xxxiii, No. 4, p. 366.

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life, such as the lungs, heart and central nervous system, and under special conditions to the skeletal muscles.[16]

Intact splanchnic nerves are necessary to the function of the suprarenal medulla, according to Cannon,[17] Dreyer[18] and Elliott.[19] The last-named investigator shows that when the efferent nerves to the suprarenal gland are cut, there is no discharge of epinephrin on any sort of reflex stimulation. Further than this, the reflex center for the control of the epinephrin output is in the medulla somewhere in the bulb between the first thoracic nerve and corpora quadrigemina. Emotional fright (Cannon, Elliott), simple anesthesia, cerebral injury, excitation of nerves, and poisoning with toxins are effective in reducing the epinephrin content of the suprarenal medulla, and act reflexly through the splanchnic nerves. So suprarenal glands are played on with splanchnic nerves in emotion and vasomotor reflex with almost as frequent call as the blood vessels themselves. For instance, stimulation of sensory nerves and psychic emotions, according to Cannon and de la Paz, produce measurable quantities of epinephrin in the blood.[17] In our own experiments we often found that traumatization of the visceral peritoneum produced epinephrinlike rises of blood pressure. From these experiments we can assume that stimulation of the afferent nerves of the viscera is analogous to pain stimulation elsewhere. Suprarenalectomized animals do not furnish identical rises of blood pressure on peritoneal trauma. The work of Elliott[20] has shown that sciatic stimulation produces not only an output of epinephrin, but actually reduces the epinephrin content of the glands. Seelig and Lyon[21] have demonstrated vasoconstriction to be present in traumatic

16. Oliver and Schafer: Jour. Physiol., 1895, xviii, 240.
17. Cannon and de la Paz: Am. Jour. Physiol., 1911, xxviii, 64.
18. Dreyer: Am. Jour. Physiol., 1898, ii, 203.
19. Elliott: Jour. Physiol., 1912, xliv, 409.
20. Elliott, T. R.: Jour. Physiol., 1912, xliv, 374.
21. Seelig and Lyon: Surg., Gynec. and Obst., 1910, xi, 146.

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peritoneal shock. This could be maintained only through the forced output of epinephrin. The output of epinephrin in peritoneal trauma is protective in function. Symptoms of shock fully develop only after the supply of epinephrin is greatly depleted. Moreover, animals deprived of suprarenals present a condition of mental apathy, reduced sensibility, vasomotor disturbance, weakness, pallor, subnormal temperature, rapid and thready pulse, and irregular respiration, exactly as they do in shock.

Aside from Wiesel's finding in status thymolymphaticus, literature is not very rich in reference to epinephrin exhaustion in shock. Parkinson[22] could not demonstrate chromaffin substance in the suprarenals in a case of postoperative shock. This has been corroborated by the work of Hornowski[23] and Bainbridge.[24]

In traumatic shock, the forced output of epinephrin seemed to me so marked that I undertook a study to determine the condition of the suprarenals in such cases. My findings lead me to consider epinephrin as a shock factor. I do not state that epinephrin loss is shock, but rather that epinephrin is necessary to overcome shock, and anything that depletes epinephrin favors the development of that condition.

In the light of the work of Elliott and Cannon, Seelig and Lyon, my own observations have led to the foregoing statements for the following reasons: In a long series of animals reduced to traumatic shock by usual methods, I found a great degree of epinephrin exhaustion to exist. In this series the final appearance of the animal was that of complete shock — mental apathy, evidenced by unconsciousness with no ether, muscular relaxation, pale mucous membrane and low blood pressure. The average blood pressure was 12, and the average epinephrin content 8 per cent. In

22. Parkinson: Tr. Path. Soc. London, 1907, p. 194.
23. Hornowski: Virchow's Arch. f. path. Anat., 1909, cxcviii, 33.
24. Bainbridge and Parkinson: Lancet, London, 1907, i, 1296.

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a few instances the blood pressure remained at from 30 to 45 mm., suddenly fell to 0, and the epinephrin content in these cases was 11 per cent. The average time to produce complete traumatic shock was six hours. Bulldogs[25] protected by morphin, not reduced to shock after four hours' trauma (average blood pressure 45 mm.), had epinephrin content of 0.35 per cent. In animals in which the suprarenals had been removed, only 1.3 hours of traumatization were necessary to produce shock. These animals showed no spontaneous recovery of blood pressure such as we get in a normal animal. Further than this, animals whose epinephrin content had been reduced by sciatic stimulation, but in which shock had not become manifest, very rapidly went into shock after a few minutes of peritoneal trauma. Boinet[18] states that suprarenalectomized rats are more quickly exhausted on exertion than normal animals. All of these traumatic shock cases, when determinations were made, showed a concentration of blood and a loss of blood in organs examined. In one instance, the blood pressure fell to 15 mm. and epinephrin content remained 45 per cent. In this case, concentration of blood was the predominant factor. Shock supervenes more rapidly in traumatized parietal peritoneum than on bowel trauma. Symptoms of shock become extreme with great suprarenal depletion. Epinephrinlike rises of blood pressure were usually absent in advanced shock. These are the cardinal reasons for considering epinephrin exhaustion as a shock factor, and using the same to express degree of shock.

Crile has demonstrated changes in the Purkinje cells of the cerebellum in shock. Without attempting to discuss the altered Nissl substance of those cells in shock, it seems to me that the truth of the following statement is apparent: If the epinephrin deficiency in the

25. Animals in this series were powerful male bulldogs, and figures are probably out of focus with the rest.

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condition which we call shock is due to failure of the reflex mechanism in the brain by which epinephrin outflow is governed, then we should have a residual epinephrin in terminal shock in the suprarenal and not an almost complete exhaustion. Very little is known of the secretion[26] of epinephrin, but from the fact that the suprarenal ordinarily contains enormous loads to tide the individual through emergencies, it would seem that the storage-discharge factor were paramount over the secretory rôles. Further than this, the amounts of epinephrin needed to maintain vasoconstriction that

AVERAGE EPINEPHRIN CONTENT

Procedure	Per. Cent.
Immediate chloroform poisoning	76
Chloroform anesthesia for 1 hour	35
Chloroform anesthesia for 4 hours	28
Ether deaths, primary anesthesia (not poisoning) frightened animals	6
Ether anesthesia, 1 hour	33
Ether anesthesia, 4 hours	24
Ether and morphin anesthesia, ¼ hour	60
Ether and morphin anesthesia, 4 hours	40
Ether anesthesia and operative trauma, 4 hours	21
Ether and morphin and operative trauma, 4 hours	34
Ether and morphin, quinin and urea block, operative trauma, 4 hours	35
Nitrous oxid-morphin-atropin anesthesia, 4 hours	65
Nitrous oxid, 4 hours	40
Local anesthesia, without preliminary morphin	27
Local anesthesia with preliminary morphin	70
Typhoid	3
Infection	3
Intestinal obstruction	7
Severe peritoneal trauma, ether anesthesia, 6 hours	9
Severe peritoneal trauma, ether and morphin, 4 hours	25
Severe peritoneal trauma, ether death, vagus inhibition	25

exists in shock are evidence of the necessity for continued output of that secretion as long as an available supply exists.

The lipoid content of the suprarenal cortex is apparently unaffected in experimental traumatic shock.

The exhaustion of the suprarenal medulla through ether and other anesthetics explains the contributory part played by these agencies in shock, as is typified in the accompanying table.

26. Biedl: Arch. f. d. ges. Physiol., 1897, lxvii, 456.

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The average epinephrin content of the normal suprarenal gland is taken as 100 per cent. The table gives the average epinephrin content expressed as percentages resulting from the respective procedures.

CONCLUSIONS

Shock is a composite, in which epinephrin exhaustion and oligemia are predominant factors. Anesthesia, pain, fright and trauma are immediate agents in producing epinephrin exhaustion as well as shock.

In addition to the references already given, the following will be found of interest:

Janeway: Ann. Surg., lix, 58.
Short: Brit. Jour. Surg., i, 114.
Cannon and Hoskins: Am. Jour. Physiol., xxix, 274.
Mann: Bull. Johns Hopkins Hosp., July 14, 1914.
Elliott: Jour. Physiol., xliv, 388.
Hoskins and McClure: Am. Jour. Physiol., xxx, 192.
Hoskins: Cleveland Med. Jour., xi, 80.
Adrenalin and Adrenalin-Like Bodies, Bull. 55, Hyg. Lab., U. S. P. H. S.
Sollmann, Torald, and Brown, Edgar D.: The Comparative Physiologic Activity of Some Commercial Suprarenal Preparations, THE JOURNAL A. M. A., Sept. 8, 1906, p. 792.
Hunt, Reid: The Comparative Physiologic Activity of Some Commercial Suprarenal Preparations, THE JOURNAL A. M. A., Sept. 8, 1906, p. 790.

ABSTRACT OF DISCUSSION

DR. J. E. MOORE, Minneapolis: About forty years ago we saw a great deal of what we called shock. I realize that many of these cases were acute anemia. Our methods of hemostasis were not so good as they are now. Now we can with impunity secure bleeding points and take all sorts of tissue along with them, with catgut ligatures. In those days we had a great deal of sepsis. Why do we see little shock today? We rarely see shock in the operating room. I realize that before eliminating these cases of hemorrhage we still had a much larger percentage of shock than today. The question arises, why? Dr. Corbett claims it is because of exhaustion of epinephrin in these cases. He says epinephrin is exhausted by sepsis. There is very little sepsis today and therefore we have removed one cause of shock. We have learned to use anesthetics more carefully and less of them, and therefore we have removed another cause of reduction of epinephrin. We are careful in the handling of our patients and the general public is not afraid of an operation today, and therefore the element of fear is taken away. And so on down the line we make the practical application of Dr. Corbett's paper. Infection, fright, too much anesthetics, etc., that lower the production of epinephrin should

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be eliminated. I am glad he states that epinephrin is not the whole thing. I am glad he looks on shock as a symptom complex. We all agree with him in that. The question I want to ask is, that if these symptoms of shock are due to the loss of epinephrin, why can't we relieve these symptoms by the administration of epinephrin?

DR. J. F. CORBETT, Minneapolis: The purpose of this paper was to show that shock developed rapidly in the absence of residual epinephrin, and by what means the epinephrin content of the suprarenal gland became exhausted. The reason for doing this was to point out methods for conserving this epinephrin content. I do not think that epinephrin administered artificially is the antidote for shock, because the amounts of epinephrin normally in the blood are exceedingly small, and if we try to maintain blood pressure by forcing epinephrin we have to use continued larger doses to maintain our results. The continuous administration of increasing doses of epinephrin has a deleterious effect on the blood vessels and might increase the concentration of the blood, adding this factor to shock.

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ROENTGEN RAY EPITHELIOMA, CURABLE BY RADIUM

AN APPARENT PARADOX

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At a section meeting of roentgenologists at the British Medical Association meeting two years ago I was impressed by the large proportion of this noble body of workers who had suffered from all degrees of Roentgen-ray injuries, from simple hyperkeratosis to amputation of one or more fingers, or one hand, or both.

I presented to them the possibility of curing the disease in its early stage by radium. Most of them seemed skeptical, but I found one physician from Australia who had suffered, and who had found in his own experience that radium had kept his hands well, as he had repeatedly applied it in this early type for some years. I showed photographs and spoke of cases which I will here quote.

During two years past, I have been more deeply impressed with its importance, as I have treated more cases. Logically, it is clear that if all of the vast number of senile keratoses and early epitheliomas of the face and hands can be cured with certainty by radium, then the early Roentgen-ray growths of the same type ought to yield equally well.

It is in the advanced stage of epitheliomas when the downgrowth of cells invades and envelops the squamous cell layer — followed by growth of pearls, lymphatic invasion and gland metastases — that no efficient action of radium, so far as we can yet see, is beneficial. Then, anything short of amputation or clean excision is without value. Subsequent to the early stage, however, most sacrifices of fingers and

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hands have taken place. It is to this point I wish to direct attention, for in the early stage I shall show that cure may be assured.

My first case so treated was in 1903. Five years after beginning the use of the Roentgen ray, the patient developed a typical epithelioma of the back of the left hand. One application of radium cured it, and there has been no recurrence after twelve years.

Three years ago a well-known maker of Roentgen-ray tubes came to me with a terrible exhibition of Roentgen-ray cancer of the chin, chest and both hands. One finger had been amputated and much useless surgery done on the other parts. Both hands had on them scores of epitheliomas of varying sizes and heights. A recurrence showed in the stump of the amputated finger with an enlarged epitrochlea lymph mass of half the size of an egg, and in the axilla and subclavian region of that side, a conglomerate mass resembling a large clenched fist. Hopeless as it all seemed, he wished me to excise the lymph and other related scar growth, and apply radium as well as possible, at least for experiment. This I reluctantly did much to his delight. During the convalescence he asked me to try what radium would do on the cutaneous epitheliomas which were, as he said, just the way the original trouble started.

I used one strong specimen of radium from my collection, and told him I had no doubt they would all be cured by applying it from half an hour to one hour each. In thirty days every one dried up and fell off, leaving a smooth healthy soft scar beneath. Even one with a half-inch base and three-quarters of an inch in height — cornified on top and very vascular at the base — was absolutely cured in the same time. The effect of buried radium in the operated field of the large axillary cancerous masses was, as I expected, of no value. The patient lived some months and succumbed to the cancer saturation, though no recurrence of the epithelial growths took place.

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Many men are living to-day, who have served their profession and the public nobly, who have hanging over them this fate, which has befallen many whom we all know. These may all share the "exhilarating sentiment of hope" through radium.

It is to these that the cases now described will appeal. Two or three examples will suffice.

One physician, illustrating a type of severe injury of the hands of one of the pioneers and foremost authorities in Roentgen-ray work, came to me two years since with both hands covered with patches of thick epitheliomas and crusted skin, cracked and sore, compelling him to use gloves and cerates for even decent comfort. During several years he had forestalled the dangerous second stage by having surgeons excise and skin graft several parts. Others had cauterized and destroyed certain considerable areas by nitric acid, with fairly smooth scars; several times he had had carbon dioxid freezing to destroy and heal: and other agents as numerous as the surgeons to whom he applied. At last he was disheartened and refused to suffer longer the pain of these treatments, the worst of which he thought was freezing. Two years ago he consulted me and I loaned him one specimen of radium to use, indicating the number of minutes for each of twenty or thirty places. The result was better, he said, than by any other surgical method he knew. A second use of it on numerous other parts so far restored his hands that he decided to marry, which the condition and prospect of his hands had wholly prevented him from considering. During the past two years he has four times borrowed my specimen to use on a few lingering places, and writes me as follows:

> The great advantage of the radium treatment, in my judgment, lies, first, in the fact that it may be applied to many situations which are not accessible to freezing, and, second, in its relative freedom from pain.
>
> I have had about three hundred and fifty or four hundred areas treated by radium, and about sixty areas treated by

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freezing. Many of these radium areas could not have been reached successfully by freezing, and because of the relative freedom from pain, it has been possible to obtain truly wonderful results with radium, with far less discomfort than was experienced with the smaller amount of freezing treatments.

These radium areas included both ulcers and keratoses, most of which could have been classed as precancerous.

I feel that the success of the radium treatment has really changed my whole life.

Ten cases of physicians whose hands, diseased by the Roentgen ray, I have treated have all shown the happy results of radium treatment.

One enthusiastic patient over 70 years of age had the usual cure of part of his hand by radium two years after I had excised and skin grafted another area, the microscope having shown typical basal-cell cancer. A third area was then treated by radium at a later date. After the fourth week, he asked me to excise and skin graft the thick scar, as it was on his mind and worried him. It gave a good opportunity for careful microscopic demonstration that no trace of disease was left, but only the subsiding radium inflammation which would have gone in another fortnight. He remains perfectly well.

In another surgeon's hands the thick crusted and ulcerated knuckle of his disabled finger has healed after the use of radium, with a soft flexible scar.

Other surgeons, who were much handicapped in their work, report the same happy termination of their anxiety and pain.

It seems almost a paradox of radiology that the accepted use of a heavy gamma radiation from a Roentgen tube will cause a diseased condition of the skin, which a similar radiation from a tube of radium will cure. This becomes intelligible when we know that the output of the Roentgen-ray tube is almost wholly composed of hard, penetrating, irritating gamma rays. The radium discharges the beta ray in great quantity, as well as the gamma ray. It is the beta ray that has been proved beyond question to be

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the efficient curative power, and it is only the secondary betas generated by the gamma when striking any resisting substance, that give it its value in the Roentgen-ray tube work. Hence, we can understand that a surface lesion of morbid cell growth, be it hyperkeratosis or basal cell, is happily cured by the large output of soft beta radiation of radium.

It is not possible that, if we could gage the output of the Roentgen-ray tube in power enough to generate the curative beta rays by impact on the superficial disease, we could certainly cure it, as well as by radium, but in so doing we would have to discharge energy enough of the hard gamma variety to be highly injurious to the deeper tissue of the vessels, muscle and skeleton.

It is most fortunate, therefore, that nature has provided just the agent which can correct the superficial evil which the Roentgen tube had caused by prolonged irritation of surface impact.

Regarding the amount of radiant energy needed in such cases, it may be said that, according to what type of radium application is used, the effect which would cure ordinary papillomas or basal cell epithelioma, is competent to cure in equal time, the Roentgen-ray growths. The sequel of an application consists in ten days' latent action, ten days' activity and ten days' quiescence, followed by desquamation of the crusts from a soft healed surface. The results seem permanent. The skin has rarely been found to be irreparably damaged by disease, and afterward, the cicatrix is thin and flexible.

To sum up, I may say that no cases have presented themselves to me of chronic dermal Roentgen-ray disease in the early stage of thick patches, cracked, ulcerated and painful, or of epithelial growths of basal-cell type on the back of the left hand of those who have in past years used that hand to test the tubes, which have not yielded to radium therapy.

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EXPERIENCES IN MILITARY SURGERY

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The ideas presented here were gained during a service at the American Ambulance Hospital at Paris during the latter part of 1914 and the early part of 1915. Hence the point of view is that of the surgeon at a large base hospital.

In any discussion of military surgery, the questions of shock and physical fitness naturally occupy a prominent place. Surgeons at the first-aid stations say that the degree of shock exhibited by wounded soldiers is much less than that seen in civilians sustaining similar injuries. It is remarkable how little shock is shown by men received at the base hospitals suffering from grave injuries 24 to 48 hours after being wounded. There can be no doubt that the mental attitude plays a considerable part in this. The wounded soldier, while discouraged and suffering, sees visions of a comfortable bed and pleasant surroundings, feels himself somewhat of a hero, and escapes at the same time from the ever present specter of impending death. In the mind of a civilian similarly injured, the mental picture is entirely different. He begins immediately to grieve over a multitude of troubles, loss of wages or position, and in civil life, gunshot injuries are not infrequently attended with shame and chagrin to the sufferer. The physical condition of the French and English soldiers speaks well for those in charge of the commissary. They were uniformly well nourished and healthy in appearance, facts which go far toward minimizing shock.

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The modern sharp-pointed, steel-jacketed, so-called humane rifle ball, despite all claims to the contrary, is remarkable for its severe and mutilating trauma. The point of entrance may be a small slit, or round wound, but the wound of exit is quite often large and ugly, with herniated muscles, giving it a mushroom, or explosive, appearance. In our Spanish war, the high velocity rifles, shooting balls of the Mauser type —that is with an oval end and with the center of gravity near the middle of the mass—made wounds which were, comparatively speaking, quite humane. The effects of the modern rifle bullets are usually classified according as they occur in one of four zones. These are:

First zone (0 to 500 yards) explosive effects.
Second zone (500 to 1,000 yards) penetrating effects.
Third zone (1,000 to 2,000 yards) simple wounding effects.
Fourth zone (2,000 to 2,500 yards) contusive wounding effects.

It is no exaggeration to say that the modern sharp-pointed bullets are all potentially dumdums, for it is the rule rather than the exception that the ball, after striking, pivots and turns sidewise. This is explained by the fact that the center of gravity is situated far back, near the base, so that the slightest deflection of the point from the line of flight is an instantaneous command for the base to swing forward. From such balls picked up on the battlefields, and some extracted from the wounded, it is seen that not infrequently the base of the bullet is deformed in consequence of striking first, while the sharp point is in nowise altered. From this, it would seem that these bullets often possess a wobbling motion, and even rotate on their transverse axis, particularly toward the end of their flight.

Modern field artillery consists, for the most part, of 3-inch field guns and 6-inch howitzers. The extreme ranges of these guns vary from 5,600 to 6,700 yards. The projectiles weigh from 15 to 20 pounds. The

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German shrapnel contains from 300 to 500 round lead bullets, hardened with antimony, which vary from 1 to 1½ cm. in diameter, and in weight from 10 to 16 grams. In the present war, more than 80 per cent. of the ammunition used by field guns is in the form of shrapnel. A 3-inch shrapnel shell may be described as a steel or brass tube with a solid base and a detachable head in which there is a time fuse. At the base, there is a charge of about 3 ounces of black powder, and in the center of the tube is a core of gun cotton to assist in the explosion. Surrounding this core are placed lead balls, which are, in turn, surrounded by the smoke-producing matrix. This latter serves as an index to the gunner to locate the point of explosion. Shrapnel will kill at 6,500 yards, at which distance it has a velocity of 565 feet per second. At the moment of the explosion, an additional 300 feet per second is imparted to the lead bullets—thanks to the powder and gun cotton. The time fuse can be cut so as to cause the projectile to explode at any given one-sixth of a second during its flight. The number of effective fragments varies from 600 to 1,500, and area of dispersion, from 400 by 200 yards to 150 by 75 yards.

The Germans have an 11-inch howitzer with a range of 8 miles, which shoots a projectile weighing 748 pounds. This strikes with an energy of 5,000 foot-tons. It requires a blow of 60 footpounds to kill a human.

The terrible efficacy of modern artillery has not been exaggerated in any degree. Shrapnel wounds are more frequent than rifle injuries, and at the same time are often multiple. Thus, in 260 wounded French soldiers, reported by Hartmann,[1] 169 were injured by artillery projectiles; 127 by fragments of shells; 41 by shrapnel bullets; only 99 by rifle shot.

Wounds caused by artillery differ chiefly from rifle wounds in that the missiles are apt to be larger, and, traveling at a lower velocity, they carry more clothes

1. Hartmann: Rev. Sc. gen., No. 9, Dec. 19-26, 1914.

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and dirt into the wounds. It is noticeable how frequently shrapnel bullets break a bone, and at the same time are arrested in the tissues. The singular of bone is used advisedly, for one rarely observes both bones broken either in the forearm or leg. It would seem that they possess just the required momentum to break any bone, even the femur or a vertebra, and this accomplished, they are content to rest and do no more.

The iron envelope of the shrapnel shell is shattered into thousands of pieces at the moment of explosion, and the wounds made by these rough masses are often severe and lacerated. It is quite puzzling how small the wound of entrance can be in comparison to the size of the fragment itself. Thus, a piece of ragged shell which had traversed the anterior wall of the axilla measured 1 by 1¼ by ⅓ inch, and, taken from the chest cavity, had a wound of entrance at the anterior border of the deltoid which measured less than ½-inch long, and was a mere slit, a phenomenon which can with difficulty be explained by allowing for the greatest elasticity of the skin.

The regional distribution of injuries in battle has been estimated as follows:

	Percentage	Mortality Percentage
Head	15	51
Neck	2	18
Perforating spine	2	75
Perforating chest	4	25
Perforating abdomen	3	65
Upper extremities	25	2
Lower extremities	30	2

As a basis for the sanitary and ambulance corps, it is estimated that the battle casualties are as follows:

	Percentage	
Killed	20	
Nontransportable — serious head and abdominal injuries	8	
Requiring transportation	32	20 per cent. sitting up. 12 per cent. recumbent.
Slightly wounded—able to walk	40	

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Patients whose injuries in the opinion of the surgeon at the classifying stations would permit their returning to the firing line within three weeks were sent to the hospitals known as the hospitals of the zone of the army. These hospitals are located within an imaginary zone extending backward about 20 miles from the firing line. Those whose injuries were most serious were sent to the base hospitals. To attempt an enumeration of the various wounds seen, bizarre effects, etc., would be endless and useless.

At the base hospitals, there were no fresh gunshot wounds of the abdomen to be seen. Now and then a patient who had survived with some complication, such as an abdominal abscess, was sent in for an operation. Acute appendicitis was fairly common. At no time did I see a wound made by the bayonet. One traumatic aneurysm was seen. The treatment of the different types of wounds varied somewhat, according to their location and extent; but, in the main, a routine was followed which was applicable to all. Roentgenograms were taken as soon as possible after admission, and used as guides in the operative procedures and after treatment. Many of the operations are merely dressings under ether. All small wounds of entrance or exit were freely enlarged, careful search being made for foreign bodies, particularly bits of clothing. Irrigation with normal salt solution was much used in the mechanical cleansing of the wound. Personally, I preferred, and used, a 5 per cent. solution of benzoate of soda, both as an irrigation and wet dressing. It acts in two ways: first, by virtue of its hypertonicity, it induces a flow of lymph in the wound, thereby lessening the chances of toxic absorption; second, it has a preservative effect on the devitalized tissue surrounding the track of the missile. It is in this dead, pulpified tissue that the saprophytes find their favorite abode. So impressed were they, in one hospital, with doing away with this pulpified tissue, that one saw the wounds being burned out with a

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large blow-pipe flame, a method which was undoubtedly too heroic. The use of benzoate of soda solution was begun somewhat late in my service, and while I have no statistics to present, I have no hesitancy in saying that it had a beneficial effect on the wounds. In no case in which it had been used did gas gangrene develop, and, in all cases, the wounds were kept sweet, and free from the terrible odors with which one often had otherwise to deal. The main point in the treatment of the wounds, however, consists in the establishment of free drainage. This is best accomplished by free incisions and the use of large, fenestrated soft-rubber tubes, varying from one-quarter to three-quarters of an inch in diameter.

The great complications most feared in military surgery are tetanus and gas gangrene. Cultures taken from wounds were teeming with aerobes and anaerobes, as well as the ordinary pyogenic cocci. It is safe to say that more than 95 per cent. of the wounds suppurated. This may be explained by the fact that this war is a dirty war in more ways than one. Bathing facilities for the soldiers, for the most part, have been entirely absent or quite limited. A wounded soldier who in civil life had been a man accustomed to the luxuries, told me that he had not bathed in more than three months. The most of this time he had spent in the trenches. The amount of tetanus now seen is almost negligible—thanks to the general use of antitoxin. In the early part of the war, Hartmann reported 36 cases developing in 2,473 wounded soldiers, and at the Hotel Dieu, of Bourg, 7 cases developed among 900 wounded. In none of these cases had antitoxin been administered. I saw one fatal case in which the infection came from frozen feet, and, unfortunately, the prophylactic dose of antitoxin had not been given. In another case, the antitoxin was administered only on the sixth day after the receipt of the injury—a shrapnel ball having passed through the right thigh and lodged in the left. Two days

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after the antitoxin was administered, that is, 8 days after the injury, symptoms of tetanus first appeared, and soon became quite marked. It is interesting to note that his wounds were closed without drainage by a field surgeon, and that he spent the first night after being injured in a stable. This patient recovered after receiving daily doses of 40 c.c. of antitetanic serum injected intraspinally, a like amount of spinal fluid having first been withdrawn. This was continued for three consecutive days, and thereafter 60 c.c. were injected daily for several days into the muscles. There is one point in regard to tetanus which has been noted in this war, I believe, for the first time; that is, that infection by tetanus bacilli is apt to recur whenever operative procedure is carried out on an old wound which has previously been the site of a tetanic infection. It has been demonstrated that the spores of tetanus may live for months in the walls of wounds or old sinuses in which the circulation is quite feeble. Such a patient may thus become a tetanus carrier, differing from the typhoid carrier, in that he is dangerous only to himself. Such cases, when they are to be subjected to a secondary operation should always be given a prophylactic injection of antitetanic serum the day before the proposed operation is undertaken.

The other great complication to be feared is the one of gas gangrene; the more so, because we have no certain means of preventing its development, and once developed, no sure method of combating it. Maisonneuve, in 1853, first described the condition. In 1864 Pirogoff named it acute gangrenous edema. Gas bacillus infections as seen in the present European conflict are usually of a mixed type, pyogenic organisms growing in symbiosis with putrefactive saprophytes. It is admitted on all sides that the causative agent is an anaerobe, or anaerobes. The *Bacillus perfringens,* which is identical with the *Bacillus aerogenes capsulatus,* is quite constant, and is generally considered as being responsible for the condition. It was present

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in all cases at Neuilly. Other bacilli which have been recorded as causative are: *Bacillus oedematis maligni, Pseudobacillus oedematis maligni,* and *Bacillus coli.*

Clinically, gas gangrene presents a striking feature. In all cases seen by me the process began in an extremity, and in every instance there had been a serious primary injury to the great vessels of the limb. There was a rapid spreading of the process, with an increasing area of anesthesia, often involving the entire limb within 36 hours. In some cases, there was a fairly distinct line of demarcation; in others, the infection was progressive and extended to the trunk and became generalized.

Gas gangrene, contrary to moist gangrene, begins at the edges of the wound and not at the periphery. The edges are at first an angry red, later become greenish, and, finally, turn black. The skin is cold and clammy, of a dark, bluish-black color, with many large blebs on the surface, and the whole affected extremity is enormously swollen. Crepitation may be felt on palpation, and the tissues to the touch give a peculiar pulpy, boggy sensation. If incised, a flow of dark bloody fluid results, which contains many bubbles of gas. The gas may be seen to bubble up from the tissue planes into the wound when pressure is exerted thereon. In drawing blood for a blood culture, in cases in which the infection has become systemic, many bubbles of gas may be seen to flow into the receptacle directly from the vein. At necropsy, myriads of bubbles may be seen in the mesenteric vessels. Dr. Benjamin Jablons, pathologist at the American Ambulance Hospital in Paris, demonstrated to me a phenomenon first observed by himself, namely: the presence of very small subperitoneal blebs, or vesicles, mostly on the intestines; but also beneath the parietal peritoneal membranes, which first make their appearance from four to five hours after death. So far as I know, they are peculiar to this condition.

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As regards the treatment for gas gangrene; many measures have been tried, and none found effective. Lawson and Whitehouse, two English surgeons, report 8 cures and 3 deaths in 11 cases treated by their method. This consists in undermining a zone of skin surrounding the extremity and well above the infected area, and injecting this area with neutral hydrogen peroxid at body temperature under pressure. At the same time, the infected area is incised, drained and treated according to general surgical principles. The use of a serum, the injection of oxygen under pressure with a large hollow needle directly into the tissues, proved of no avail. The best results were obtained by multiple incisions, which gave free drainage and undoubtedly aborted some incipient cases. In these cases, despite the large amount of drainage from the wounds, heavy dressings should be avoided in order to permit direct contact of the air with the wounds as freely as possible. When amputation has been decided on, it must be done high up and the wound left open. In five such cases with amputation the patients recovered. In the malignant cases, in spite of every effort, the end came rapidly, preceded by delirium.

The question of gas gangrene is one of paramount importance to the military surgeon, and as yet the last word on this subject is far from being said.

Secondary hemorrhage constitutes another complication against which one must guard. During my service, there were two deaths from this cause.

Joint injuries were common. Six cases of infected knee joint were seen, all of which recovered, drainage and extension being employed. In no case were the crucial ligaments cut, or the joint resected.

Of even greater interest are the compound fractures. One sees, sooner or later, practically every bone in the body broken. These fractures differ from those in civil life chiefly by the greater displacement of the

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Fig.1.—Showing type of ambulance body used on Ford chassis.

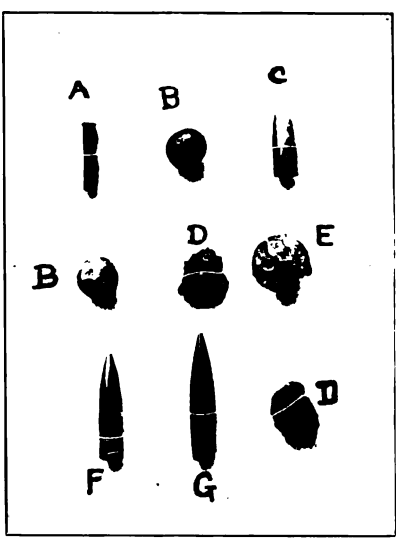

Fig. 2.—Various missiles: *A*, rivet; *B*, small sized shrapnel; *C*, German rifle bullet; *D*, *D*, pieces of stone; *E*, large size shrapnel; *F*, English rifle ball; *G*, French rifle ball.

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Fig. 3.—Mutilating effect of rifle ball at 600 yards. Complete avulsion of lower jaw. Ball barely touched shoulder, which caused it to pivot. Little shock. Recovery.

Fig. 4.—Shrapnel wounds, patient dead. The instructions to the soldiers are, namely, to fall prone when a shell is expected to explode nearby.

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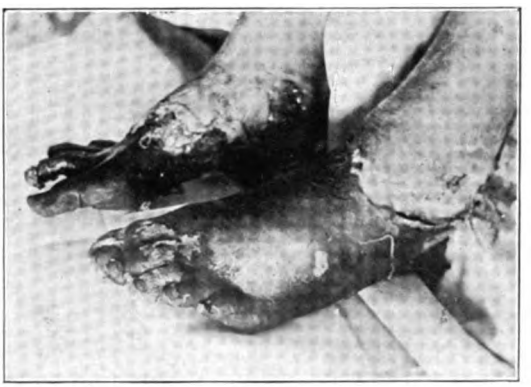

Fig. 5.—Condition of feet from frostbite in the trenches January, 1915. Feet were frozen ten days before picture was taken. Amputation resulted in recovery.

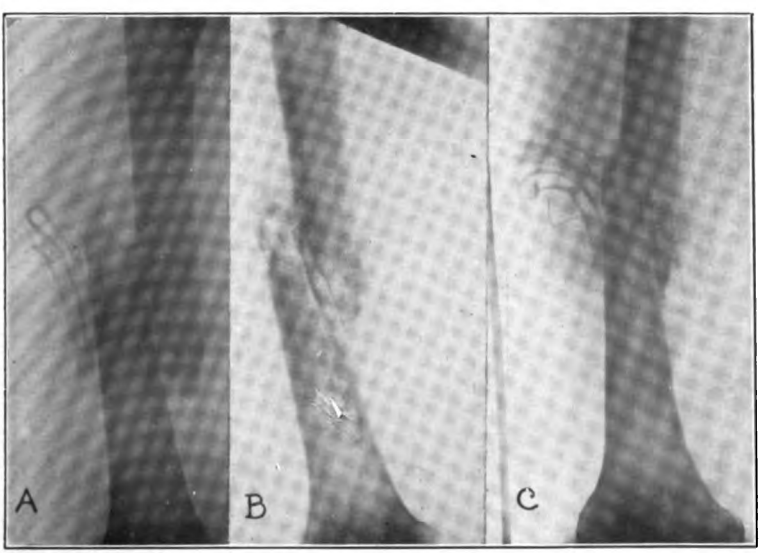

Fig. 6.—*A*, compound infected fracture of femur. Roentgenogram shortly after injury. Drainage perfect, extension not yet applied; *B*, fracture one week later. Drainage good, extension applied, by Dr. Blake's splint; very slight inflammation of ends of fragments; *C*, fracture one month after injury. Extension has effected good position. Drainage has prevented necrosis and loss of tissue, by maintaining nutrition.

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Fig. 7.—Compound infected fracture of humerus, shell wound. Course complicated by typhoid fever. Drainage of upper fragment good. Large sequestrum of lower fragment, the result of insufficient drainage. Roentgenogram ten weeks after injury.

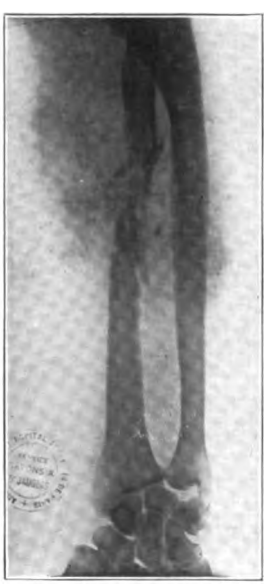

Fig. 8.—Illustrating tendency to fracture only one of two bones in same location. Upper third of ulna beginning to thicken, due to stimulation of zone of irritation. Ulna not injured.

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fragments, greater splintering and comminution of the bones and the tendency toward limiting the injury to one bone where there are two in an extremity. Fractures of the extremities are very common, as might be expected from the high percentage of wounds received in these parts. It is in reality just these cases which tax the judgment and ingenuity of the surgeon, for they constitute the greatest problem seen at the base hospital. Needless to say, they are all infected.

Pathologically, a compound infected fracture may be compared to a common boil.[2] A boil comes from pyogenic organisms which have gained entrance and lodgment in the subcutaneous tissues. The infection takes place through some microscopic wound or an abrasion, and thus, in a sense, the wound has been for the moment compound. The germs grow and give off products of their activity, and the tissues, in their turn, react against them. The capillaries dilate, the blood stream becomes slow, leukocytes emigrate, some forming a protective barrier about the periphery of the inflammatory process, others destroying microorganisms by phagocytosis, and still others perish in the struggle and become partially distintegrated and go to form pus. Just inside the protective zone is a layer of innermost living cells, which I shall call the zone of nutrition. This zone is by no means stationary, for it fluctuates back and forth with barometric sensitiveness, as an index to the pressure within. It is this shifting zone of nutrition which concerns us most in these cases. Still further out is the zone of irritation, in which the circulation is increased, metabolism accelerated and the powers of repair heightened. If now proper drainage is established, that is, if the small boil is incised—a drop or two of pus escapes—tension is relieved by drainage. This allows

2. For suggesting the pathologic similarity between a compound infected fracture and a boil, I am indebted to my friend Dr. Hugh Auchincloss of New York.

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the zone of nutrition to press in on the infected area, the necrotic tissue is removed and healing rapidly occurs.

If, on the other hand, drainage is not obtained, tension increases within, and the zone of nutrition is forced further and further back, with the result that the central portion of the now small abscess, loses its nutrition and dies. The living cells attack the necrotic mass at its periphery and cause an anatomic separation of the dead from the living. This central necrotic mass, the laity speak of as the "core." When the core is removed by incision, tension is relieved by drainage, the zone of nutrition encroaches on the abscess cavity and the wound is healed by granulating, the destroyed tissues being replaced by new connective tissues.

In compound infected fractures, it is exactly the same thing. Every such fracture constitutes an abscess cavity. The core, when it is made of bone, we call a sequestrum. The zone of irritation, with its increased powers of repair, we call the involucrum, and the zone of nutrition, or the innermost layer of living cells, is formed from the innermost layer of the involucrum.

If, in these cases, sufficient drainage is obtained and maintained, tension will not occur, and good nutrition of the fragments within the infected area will be assured. In this way rapid restoration with but little or no loss of tissues will occur. However, if drainage is poor or imperfect, tension will occur, the nutrition of the tissues will be impaired or destroyed, and the formation of a sequestrum with healing long delayed will result.

In operating on compound infected fractures, it is important,

1. To make large incisions; it is usually best to make the incision so that it will be dependent.

2. To remove all foreign bodies.

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3. To remove all loose or detached pieces of bone. The fingers form a good guide to go by. All pieces that can be removed by the fingers without undue effort should be taken away.

4. To maintain drainage; this is best done by the insertion of large fenestrated rubber tubes.

5. To use absolutely no foreign material of any kind in the wound, such as wire, chromic gut or bone plates; the use of these means nothing but trouble.

6. As to the question of amputation, the tendency is rightfully more and more toward conservatism. Under favorable conditions, it is marvelous what nature will do in the repair of broken and infected bones. It is now possible to save limbs and restore them as useful members, whereas formerly it would have been considered entirely correct to amputate. If the economic status of the patient is not to be considered, the question of amputations becomes more and more identical with the question of the limb's viability. With the recent additions to our knowledge in the realms of bone grafting and transplanting, many wonderful results are being obtained.

The after-treatment of compound infected fractures consists in the maintenance of drainage and extension. Both are most important. Dr. Blake has advised a very simple and effective apparatus for extension of the lower extremity. It is much like a Thomas knee splint, resting above against the tuber ischii, the great trochanter and the pubic bone, and extending below well beyond the plantar border. He also made another such apparatus for use on the humerus. Both are made of metal, and can be bent in individual cases to permit of dressing wounds at any location.

The soldier permanently disabled, or injured so greatly as to prevent his return to the army, begins to turn his mind toward the pursuits of peace, toward industrial activity. So in just such cases do we find

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the surgical problems approaching those of everyday peaceful life. It is here that various plastic operations, repair of nerves, transplanting of bone and other tissues are finding a useful field. All Europe will soon be one great laboratory for such constructive surgery, and he who can will do well to avail himself of the opportunity.

I should be most ungrateful if I did not say that for the entire trip I am indebted to the generosity of Mrs. Harry Payne Whitney, with whose party I went to France. For the actual work, the operations done, the privilege of using the roentgenograms and the clinical material, and everything else, I am indebted to Dr. Joseph A. Blake; Dr. Charles W. Du Bouchet I wish to thank for permitting me to take many pictures and for other kindnesses. I am indebted to Dr. Jaugeas and his assistant, Mr. King, for the Roentgen-ray work, and to Dr. Benjamin Jablons for the privilege of seeing necropsies and pathologic work.

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THE INTESTINAL TRACT

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Man's interest in the intestinal tract begins at birth and ends only with death. Through its long and tortuous canal pass the foods that supply the body, and here in its laboratory are carried on those complicated chemical and mechanical processes that allow these foods to be fitted for the use of the animal machine, and finally eject the unused portions. Anything interfering with any of these functions is a cause of discomfort, and even of death itself. Is it not natural, therefore, that those having the physical well-being of man in their care, should, from the earliest times, have sought to remedy bodily ills by medication applied to, or through, this channel, confidently hoping that all human disorders might thereby be cured. This hope and even belief still exists, filling the purse of the quack and "patent medicine" manufacturer, who today largely occupies the place of the sorcerer and medicine man of savage tribes.

Medication of some sort, then, was the only method for years, so far as we know, of treating the digestive tract. There were bold and not unskilful surgeons in the older civilizations, as witness the formidable operations on the skull and perhaps the brain, shown by the great number and variety of trephinings done with instruments of stone, found in Peru and elsewhere. These mummies and their bones have handed down their story through the centuries, and in them we can recognize the operative successes and failures as plainly as though these men were alive today, or perhaps on the necropsy table.

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There is no such record, however, of operations on the intestinal tract; perhaps they were performed, but even in the mummy we find nothing to suggest it, though in the mummy have been found evidences of appendicitis. It is possible that in the prehistoric as well as in later days, torn or cut intestines protruding from a wound may have been sewed up and the patient cured.

The surgeon first operated on the beginning and the end of the intestinal tract, operations on the esophagus and rectum being done at a comparatively early date, but the peritoneal cavity was supposed to be such a dangerous region that few invaded it.

The real beginning of intestinal surgery was not more than fifty years ago, and step by step it has advanced until today there is not an inch of the canal or any of its appendages that has not been attacked. It may be well to briefly mention here some of the things that have already been accomplished.

Beginning with the esophagus, we find that the congenital or acquired malformations, like pouch, may be cured, sometimes by excision, sometimes without, strictures dilated, and malignant growths at least exposed to the view of the surgeon. Excision of such growths, however, is still in the early experimental stage and should not be attempted by the general surgeon. There is no organ more difficult to reach or more dangerous to operate on than the esophagus in the thorax. Some day, let us hope in the not distant future, excision of esophageal growths will be one of the recognized surgical procedures.

Certain surgeons who have had large experience in thoracic work, experienced in the technic of differential pressure, either by the use of the cabinet, or with intratracheal anesthesia, are working and experimenting in this field, and excision of the esophagus, in man, should be left in their hands for the present—

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enough has already been accomplished to show the probability of future success.

The stomach is certainly a most tolerant organ. For years it is generally either starved or overfed. It must receive and take care of all kinds of substances from milk to clay. It is tanned with tea, irritated by alcohol, tortured by drugs, alternately scalded and chilled, and yet it works on, doing its best though receiving the blame which should fall on its owner or the other organs. Some people complain of their "bad stomachs" all their lives, while in reality the poor thing is not at fault and is doing its best. Its great failing is that it is too sympathetic, reflecting the troubles of its neighbors.

It is also abused surgically without showing resentment. Being by nature a cleanly organ and not infested with the dangerous fauna and flora of the lower intestine, it is operated on with comparative impunity. Were this not true, the daily mortality from operative procedures, some good, some indifferent and many bad, would be enormous. It is cut into and cut out, it is stitched into faulty positions, puckered and drained, properly or improperly, but still the patient survives. Formerly, the would-be surgeon, just out of the medical school, began his operative experiments by amputating a breast, one of the most difficult of operations, by the way, if properly done, but now he is not satisfied until he has done something to a stomach.

In 1881 it was my great privilege to see Billroth do the first successful resection of the pylorus—that was really the beginning of gastric surgery as we know it today. Step by step it has advanced, until now there are few more brilliant results to be obtained by the skilful and judicious operator than in this field. Men are saved from years of suffering, invalidism and death itself by the surgeon who knows his business.

The question of the treatment of malignant disease of the stomach has been pretty thoroughly settled in

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the surgical mind, radical excision in early cases giving a fair percentage of cure with slight operative mortality. Excision of chronic ulcers is an accepted fact, and operations for pyloric stenosis, whether by the Finney operation or by gastro-enterostomy, give brilliant results. Duodenal ulcer has become a surgical disease in a great measure, the only question in the choice of operation being that of excision or non-excision of the affected area. In passing, mention should be made of the importance of a thorough examination of the gallbladder in all cases in which an operation is being done for pain or other symptoms in the right upper quadrant. We have all been disappointed after an apparently successful operation for well-marked duodenal ulcer to find on second operation that the symptoms were partly due to an inflamed "strawberry" gallbladder, or small, previously unrecognized, gallstones.

Having spoken of the gallbladder, whose troubles so closely resemble those of the intestinal tract itself, and for which they are often mistaken, I cannot forbear to touch on a question that has always interested me, namely, shall it be excision or drainage in cholecystitis. For years I advocated and practiced excision in the large majority of cases, until, persuaded by surgeons of larger experience than mine, I adopted drainage for a time, only to return with greater zeal to excision, feeling sure that my ultimate results would be better. The greater mortality of cholecystectomy is due, I am sure, to the fact that it has been done in the severer cases that could only be cured in that way. There is, however, no doubt that in inexperienced hands cholecystostomy is safer, and under such circumstances should be the operation of choice. Many of my former advisers today excise in a large proportion of their cases.

It should be borne in mind that in certain desperate cases of large perforations of the duodenum, when

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the condition of the patient is so bad that a prolonged operation will not be tolerated, simple drainage with gauze or a large tube, with no attempt at closure of the opening, will often save the patient's life, and the resulting fistula may close of its own accord.

With the small intestine the surgeon has less to do. Occasionally tumors are met, intussusception being one of the common ways of first disclosing their presence, but we may have that rare type of malignant growth, a lymphoid tumor, which may have become generalized before symptoms have called attention to its presence. Adhesions or kinks from acute inflammation are the chief source of danger in this region, and in acute obstructions above the cecum the question of gallstone ileus is always to be borne in mind.

Near the ileocecal valve, congenital or acquired peritoneal folds (the so-called Lane's kink), should always be looked for in operations in this region, for in the past many of the unsuccessful attempts to cure attacks of supposed chronic appendicitis were due to the failure to recognize this very common condition, which is so often the cause of severe ileal stasis.

And now we come to that much abused and vicious organ, the appendix. Probably more necessary operations on the appendix have been left undone, and more unnecessary operations have been done on it, than on any other organ in the body. The first symptoms of inflammation should be a reason for its removal, but too often are these symptoms mistaken. The retrocecal perforation of the appendix is often unrecognized until a rupture of the abscess causes a diffuse peritoneal infection, or, on the other hand, the innocent appendix is removed, and the offending fallopian tube, ureteral stone, gallbladder or Lane's kink is left behind. The surgeon should be careful and conservative in his diagnosis of the appendiceal trouble and radical in his treatment. It must always be remembered that the stomach is often blamed for trouble that really exists in the appendix.

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The large intestine has been a fruitful field for much heated discussion and surgical adventure of late. Since the advent of the Roentgen ray, much has been learned and many mistakes have been made. It is safe to say that the old ideas of the positions of the abdominal viscera have undergone a great change in the last few years. Their positions and shapes are becoming better known, and what a short time ago were considered malpositions or malformations are now known to be but slight variations from the normal, if there is such a thing as a normal arrangement. The large intestine is a marked example of this rule; it never lies in the regular lines and curves as shown in the diagrams of the old anatomist. There are innumerable variations, due to congenital or acquired folds of the peritoneum, and many have too quickly decided that anything unusual must be a serious physical defect, and the cause of certain trains of symptoms. The rules for the treatment of malignant disease are well recognized, but it is in questions of abdominal plumbing, if we may use the term, that opinions differ most widely. Fecal stasis is recognized as an evil, and many operations have been designed and performed for its relief that are useless or do positive harm. The surgeon who looks on every such case as one whose faulty plumbing must be restored mechanically to a diagramatic form is sure to make mistakes, having overlooked the real source of the trouble. Ptosis does not, or should not, always mean operation.

The interrelation of fecal stasis and the neuroses and autointoxications of all kinds are subjects that require further investigation and study, though day by day and year by year our knowledge is steadily advancing. The medical clinician, the neurologist, the psychologist, the bacteriologist must each do his part, and they should be aided, not overshadowed by the roentgenologist, whose mechanical findings may so often be misinterpreted Viewed from the standpoint

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of any one of these, the observer sees but one part of the composite picture.

The relation of intestinal abnormalities and distortions to mental disease has always interested me. It is certainly a suggestive fact that a considerable number of cases of megacolon and giant sigmoid are seen in insane asylums. I have, by an operation for acute volvulus in such a case, restored a man to a normal mental condition, after he had been a frequent inmate of the asylum for a considerable number of years. In all these cases of suspected faulty plumbing, it is generally harder to decide which individual needs to be operated on and just which form of operation should be chosen, than to do the mechanical part of the operation itself. With the abdomen open before us it is not always easy to decide which fold or which adhesion is at fault, whether the intestine can be sidetracked or whether it needs excision, and all these factors enter into the subsequent cure or failure. The intestine is not a simple pipe that can be cut and soldered, or placed in what is considered the proper position and kept there, but it is a thin-walled affair in constant motion, always expanding or contracting, and changing its position with the position of the patient and the load it has to bear. We are apt to see only the collapsed intestine on the operating table and cannot picture to ourselves that same intestine distended, partially paralyzed after operation, and carrying its load of gas and fecal matter later. What we know already has been learned at the cost of many failures, and greater future knowledge must come from earnest, careful investigation and honest observation and study of the subsequent history of each individual case. We must try to find out why one case is a success and another, treated in the same manner, is a dismal failure. We must endeavor to recognize those bands or adhesions about the intestine which are of importance in operation and those that

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are unimportant. The less traumatism to which we subject the peritoneum the better.

We do not know why certain simple operations are followed by extensive and firm adhesions, while others much more extensive, or in the presence of sepsis, are free from these dangerous results. Gentleness in manipulation, wet gauze instead of dry, leaving as few raw surfaces as possible probably help. It is assuredly a fact that adhesions may in many cases be divided, and large raw surfaces left, without the formation of new, or the reformation of old adhesions. Until we understand the reason for this and the correct method to be followed to avoid them, we can never be sure of our ultimate results.

Great advances in the treatment of intestinal stasis have been made of late and many patients saved and made useful citizens by suitable operation on the large intestine, but cases should be carefully studied and selected before operating.

The large intestine is more frequently the seat of obstruction than any other part of the tract. An operation, to prove successful, should always be done early, and the cardinal rule is not to attempt too much, and an anastomosis or the temporary artificial anus will save many lives when the primary resection will prove fatal. Excision of a growth may be done later with much greater safety, and the removal of the disease, if it is malignant, can be much more radical. Never leave a patient with an artificial anus without his full knowledge of what it means, and his consent.

Diverticulis is one of the affections of the large intestine that is not infrequently met, and the choice of operation, or even of no operation, is often difficult. When there is a perforation there is of course no question, the abdomen must be opened and the abscess drained the same as an appendix abscess. We sometimes mistake the chronic or subacute cases for malignant disease and do a resection, our mistake in diagnosis being discovered only by the pathologist.

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One meets undoubted cases of diverticulitis with recurring symptoms. These cases, as a rule, are relieved though not cured by thorough lavage. What are we to do in such cases? We know that the presence of the pathologic condition is a menace to the health and life of the patient and may be the starting point of malignant disease. On general principles we should remove the offending region, as we would remove a chronic appendix, but the operation is not a safe one and the mortality must be high, especially in those cases in which the lower end of a short sigmoid is involved.

The modern operation for cancer of the rectum gives such good results that radical extirpation should always be attempted in suitable cases.

Up to this point I have considered only the more important operations on the intestinal tract and their advisability, but now comes a more serious question—by whom shall these operations be performed? This applies to all surgery, but particularly to intestinal work, for any man who begins his experiments on man attains final success only at the expense of many lives and much unnecessary suffering. No man should ever attempt a serious operation until he has had a thorough training under a good master.

Throughout the country have sprung up thousands of small hospitals which mark a tremendous advance in the cause of human welfare, and in which is done an enormous amount of surgery, good and bad. In many of these hospitals the staff consists of all the reputable physicians in the town; in other words, any man who holds a degree, whatever his surgical experience, can send his patients there and operate on them. Many of these men have had no suitable training and their work can be imagined, but it is seldom described. The establishment of the American College of Surgeons is a step in the right direction, but only a step. It is perhaps impossible at present, but in time the rule may be made that no man shall practice surgery until

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he has served a term as an intern at some good hospital and has had a chance to observe and assist competent operators.

Medical education is constantly advancing, and greater efficiency is the aim always before us. At present, large numbers of practitioners, young and old, visit the different famous surgical clinics of the country, and then go home and try to repeat the operations that they have seen performed so easily by the master hand. Such observation and experience, to the man not properly trained, only renders him more dangerous to the community in which he lives. For intestinal work especially, it is unusually dangerous for a man to operate on a human being until he has performed many operations on living animals. Until he has the necessary skill and technic, he is bound, unless possessed of unusual ability, or more often luck, to have many failures, and a failure means a human life.

A witness before a parliamentary committee in England once said: "Gentlemen, with or without the sanction of the law, vivisection must and will continue, surgery cannot stand still, and is it not better that vivisection be done on the lower animals rather than on you, your wives or your children?"

I once assisted a famous surgeon who was performing his first intestinal anastomosis, in the days of Senn's plates. I suggested that his first knot was not drawn tightly enough, but he was sure it was all right. At necropsy he found that he was wrong; had he operated on animals before operating on a man the result would probably have been different. One cannot do these things by seeing them or reading about them. We all make mistakes enough, let us not add to these, unnecessary ones for want of proper preparation.

American surgery today is in the foremost rank, but let us not be content with that; a famous future can be ours, but it must be achieved by constant work

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and study. The standard must be raised still higher and surgeons must be trained more thoroughly for their work; graduate schools of surgery, large clinics where men can live and work long enough to acquire some of the art and skill of the master, more operations on the lower animals, both in the medical school and hospital laboratories, and greater observation and practice in the after-treatment of surgical cases, all these must be within the reach of the would-be surgeon. Technical skill in the surgeon is important, but of greater importance is surgical judgment. Many a man is, or can become, a skilful operator, but he needs to be something more. In operations on the intestinal tract, often more depends on knowing when to operate and what to do, than in any other part of the body. Of what advantage is it to the patient that a successful excision of the large intestine, for instance, or an anastomosis to side track it be done, if it does not improve his condition, having been performed when it was useless or unnecessary. The man of sound surgical judgment will save more lives and benefit humanity more, even though he be clumsy, than the man who is quick and dexterous but devoid of that essential requirement. The ideal surgeon possesses both qualities, and it should be the aim of every man who claims to be a surgeon, to perfect himself in every side of his art. Much has been written about intestinal surgery, but there are many problems yet unsolved, and it is the trained surgeon who must find the solution.

This subject is a live one which is being carefully studied and worked over. There is still work ahead, for no question that is open to discussion can be considered as settled.

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GASTRIC ULCER

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Ulcer of the stomach is a more serious condition than ulcer of the duodenum but fortunately is less frequent, our statistics showing twenty-seven of the stomach to seventy-three of the duodenum. Gastric ulcer is the more serious because of the resulting deformities which permanently cripple the stomach and, when extensive, interfere with gastric digestion and motility. The mechanical condition can be relieved by operation, but the physiologic function of the stomach is often more or less permanently impaired. In ulcer of the duodenum the gastric motor and secretory functions are not disturbed and, in the presence of gastro-enterostomy, are continued in an efficient manner.

Acute perforation in ulcer of the stomach is less common than in ulcer of the duodenum, but in the former there is less probability of the ulcer being protected by adhesions. The gastric capacity is large so that considerable contents may escape. Since the contents are relatively much less sterile than in the duodenum, there is a greater chance of perforation producing general septic peritonitis. When operations are performed for acute perforation of gastric ulcer, the opening will often be found in the center of a large calloused area, making closure difficult.

Hemorrhage occurs in both gastric and duodenal ulcers with about the same degree of frequency and danger, but in the stomach it may be gastrotoxic in origin. So true is this that the large majority of severe hemorrhages from the stomach which are not preceded or followed by the ordinary signs and symptoms of

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ulcer are not due to ulcer but to gastrotoxic conditions the result of some type of gastro-intestinal or hepatic poisoning.

There is, in gastric ulcer, the ever present danger of cancer developing on the ulcer, a danger to which duodenal ulcer does not appear to be liable. Finally, the operative procedures which must be carried out for the relief of gastric ulcer are more serious than in duodenal ulcer; there is, moreover, a somewhat larger mortality and a somewhat smaller degree of certainty of cure. The history and clinical symptoms of a typical duodenal ulcer are so distinctive that, as Moynihan[1] has pointed out, the diagnosis might be made by correspondence; but many duodenal ulcers are not typical in their symptomatology and this is even more true of gastric ulcers. Therefore, in a very considerable percentage of cases, an exact differential diagnosis between duodenal and gastric ulcer could not be established until the advent of fluoroscopy. In duodenal ulcer hyperperistalsis of the stomach and deformities of the cap and, if obstruction exists, bismuth retention, give a typical appearance and are almost as typical as the roentgenographic appearance of the niche in gastric ulcer and the appearance of hour-glass and other deformities.

Usually, the pain in duodenal ulcer comes later and radiates from the epigastric midline to the right; in gastric ulcer it may radiate to the left. When posterior adhesions of gastric ulcer exist, especially when the crater involves the pancreas, pain in the back is a frequent symptom.

Gastric ulcer is more frequent in men than in women, 71 males to 29 females, and is single in the large majority of the cases. The proportion in duodenal ulcers is 83 males to 17 females.

The occurrence of carcinomatous change in gastric ulcer has been a mooted question from those who

1. Moynihan, Sir Berkeley: The Gifts of Surgery to Medicine, Address, Brit. Med. Jour., 1913, ii, 169.

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believe with Aschoff[2] that it is a comparatively rare phenomenon, to those like Moynihan,[1] Wilson,[3] MacCarty[4] and others, who believe that it is a very frequent condition. The opinion of the postmortem pathologist who studies only the end results has no such value as the opinion of the clinical pathologist who has an opportunity to make the examination during the life of the patient, an opportunity which the operative removal of gastric ulcer and carcinoma has made possible. Fütterer[5] pointed out the relation of fish-hook ulcer to gastric carcinoma and presented proof that malignant change actually took place. Wilson[3] and MacCarty[4] from the study of a large number of specimens showed that it was not the base but the overhanging margin of the ulcer which became carcinomatous. A review by Wilson[6] of the later histories of 19 cases in which a gastric ulcer had been excised and diagnosed as probable early malignancy, in 1909, has been of very great value in clearing up the question, as four of these patients have since died of gastric carcinoma. Accepting as correct Aschoff's[2] criteria that if the base of the ulcer is carcinomatous the ulcer has been carcinoma from the beginning, Wilson was able to show in the excised specimens that the carcinoma had developed on the margin of the ulcer, as the base was of cicatricial tissue and free from cancer.

A study of the cases reported by von Eiselsberg[7] is interesting. He shows from the ultimate history of patients operated on in his clinic for gastric ulcer that 10 per cent. have since died of cancer of the stomach.

2. Aschoff, L.: Ueber die mechanischen Momente in der Pathogenese des runden Magengeschürs und über seine Beziehungen zum Krebs, Deutsch. med. Wchnschr., 1912, xxxviii, 494.

3. Wilson, L. B.: Studies in the Pathology of Early Gastric Carcinoma, Colorado Med., 1914, xi, 366.

4. MacCarty, W. C.: Precancerous Conditions, Jour. Iowa State Med. Soc., 1914, iv, 1. Wilson, L. B., and MacCarty, W. C.: Pathologic Relationships of Gastric Ulcer and Gastric Carcinoma, Am. Jour. Med. Sc., 1909, cxxxviii, 846.

5. Fütterer, G.: Treatment of Chronic Round Ulcer of the Stomach, THE JOURNAL A. M. A., Jan. 11, 1902, p. 76.

6. Wilson, L. B., and McDowell, I. E.: A Further Report of the Pathologic Evidence of the Relationship of Gastric Ulcer and Gastric Carcinoma, Am. Jour. Med. Sc., 1914, cxlviii, 796.

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The differentiation between ulcer of the stomach and duodenum was not so well established at the time these operations were made as now and the series showed few duodenal ulcers. It may be surmised that a percentage of the ulcers near the pylorus were duodenal, not gastric, and yet had been classified with the gastric. Since a duodenal ulcer rarely undergoes malignant change, this would increase the relative percentage of secondary gastric malignancy by whatever that error may have been. Analyzing von Eiselsberg's[7] statistics still further, it is found that thirteen patients died with carcinoma following operation for ulcer. The total number of deaths was forty-one. In other words 32 per cent. of all the deaths following operation for gastric ulcer were from gastric cancer. Recent data from the clinics of Payr-Perthes, Küttner and others show the same results.

Wilson[8] has contributed materially to the theory that detached fragments of functionating gastric epithelium buried in the ulcer by scar tissue may be the starting point of carcinomatous change. While it is not justifiable to say that all carcinomas of the stomach have their origin in ulcer, there is sufficient evidence to show that a preceding lesion in the gastric mucosa is practically always present before carcinoma develops. The prevailing skepticism on this point is not justified by the facts and tends to prolong medical treatment of chronic cases which would be more promptly treated by the surgeon were the carcinoma liability in addition to the ulcer risk and disability better understood.

Opinions as to the medical cure of ulcers are based on the frequent cessation of symptoms which, for that matter, occurs with or without treatment. When supposedly cured cases are operated on during the quiescent interval, the ulcer is not found to be cicatrized, but unhealed. The roentgenogram shows the same condition. While no one would contend that every

7. Von Eiselsberg, F. A.: The Selection of the Method of Operation in the Treatment of Gastric and Duodenal Ulcer, Lancet, London, 1914, ii, 296.

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gastric ulcer should be surgically treated, we at least should agree that if permanent cure does not take place within a reasonable period, other things being equal, the patient should have surgical treatment.

Thirty per cent. of all cancers in civilized man are in the stomach. The relative infrequency of the disease in primitive man and the lower animals suggests that there is some cause for this preponderance; that is, since the food of man and the lower animals is of the same character there must be something in its preparation or method of taking which predisposes civilized man to gastric cancer. There are many well-known illustrations of the fact that chronic irritation from heat disturbs the epithelium, thus making malignant disease possible. It has been shown that when a considerable quantity of fluid is taken into the stomach it passes by the canalis gastricus[8] along the lesser curvature and directly to the duodenum without mixing with the food mass in the fundus. This is exactly the situation of 85 per cent. or more of all ulcers and cancers of the stomach and ulcers of the duodenum. Food is cooled during mastication but liquids are often swallowed hotter than can be borne comfortably in the mouth. One cannot help thinking that hot drinks may be one of the most important irritative causes of chronic ulcer and precancerous lesions. Extreme cold may have the same effect. Primitive men and animals do not take their drinks hot and seldom have gastric cancer.

PYLORIC ULCER

The location, size and relations of gastric ulcer are extremely important from a surgical standpoint. The conditions created vary from the simple problems presented by a pyloric ulcer with obstruction, to those more complex problems represented by hour-glass contractures and extensive posterior ulcerations involving the pancreas. Ulcer of the pyloric end of the stomach

8. Jefferson, G.: The Human Stomach and the Canalis Gastricus (Lewis), Jour. Anat. and Physiol., 1914-1915, xlix, 165.

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and antrum should not be mistaken for duodenal ulcer. When ulcer occurs in the terminal one and one-half inches it is prone to develop a tumor, which, with the edema and obstruction, may and probably will be mistaken for carcinoma. When operating during an exacerbation an unusual amount of hypertrophy and edema in the immediate vicinity of such an ulcer will be found. The mass can often be felt through the abdominal wall on palpation. Cases are frequently reported in literature in which the two-stage operation for cancer of the stomach was planned and after a preliminary gastro-enterostomy the tumor completely disappeared. It is reported that one of Billroth's early patients on whom gastro-enterostomy was done for supposed carcinoma of the stomach, lived twenty years following operation. In our earlier experience several patients in whom a gastro-enterostomy was done for what appeared to be a fixed, inoperable malignant growth of the pyloric end of the stomach, clinically not distinguishable from cancer, lived five years or more following simple gastro-enterostomy. With increasing experience one finds that there are differentiating signs between pyloric cancer and ulcer when the tumefaction is exposed. A greater amount of edema, more extensive adhesions and more fixation occur in ulcer than usually occur in cancer of the same size. Ulcer does not present those little separated carcinomatous foci in the vicinity of the growth from dissemination just underneath the peritoneum. The glands are usually enlarged in both ulcer and cancer, and the removal of such glands which do not show cancer is unfortunately not conclusive, because glands enlarged from sepsis often exist in connection with cancer but in which the glands themselves have no malignant cells. MacCarty and Blackford[9] have called attention to the fact that the size of a regional lymphatic gland is no criterion of the presence or absence of gastric cancer.

9. MacCarty, W. C., and Blackford, J. M.: Involvement of Regional Lymphatic Glands in Carcinoma of the Stomach, Ann. Surg., 1912, lv, 811.

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In the differentiation between pyloric ulcer and ulcer of the duodenum, the pyloric veins are an important diagnostic aid (Fig. 1). Above and below the pylorus short, stumpy veins come up on each side and give off one or more veins, sometimes anastomosing across the anterior surface, sometimes ending in a little spray of vessels. Once having observed the peculiarity of these pyloric vessels, which are quite different from those in any other situation on the stomach, differentiation is easy.

The Rodman[10] operation of pylorectomy and partial gastrectomy for this particular group of ulcers is remarkably well adapted to give relief; it removes the cancer liability and also a considerable portion of the acid-forming part of the stomach and this removal is of importance in reducing the possibility of the production of that rare but serious after-result of gastro-enterostomy, the jejunal ulcer. It should be remembered, however, that the mortality of the Rodman operation is somewhat greater than simple gastro-enterostomy, and that simple gastro-enterostomy will usually cure the patient. The Rodman operation, therefore, should be reserved, first, for those patients in whom the physical conditions are such that the operation can be performed with a minimum risk, and, second, for those patients in whom the possibility of cancer amounts to a probability, so that the increased risk of the operation will be more than counterbalanced by the benefits to be derived from it.

ULCER OF THE LESSER CURVATURE AND ANTRUM

The work of Forssell[11] in showing the gastric tendon of the lesser curvature of the stomach is very important in relation to ulcer of the lesser curvature, and explains why the simple excision of an ulcer without

10. Rodman, W. L.: Excision of the Ulcer-Bearing Area in Gastric Ulcer, THE JOURNAL A. M. A., Sept. 17, 1904, p. 801.

11. Forssell, G.: Les rapports entre les formes radiologiques de l'estomac humain et l'architecture musculaire de la paroi stomacale, Arch. d'elec. med., 1912, xx, 529.

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gastro-enterostomy may fail to effect a cure even though the pylorus be not obstructed. It would appear that the portion of the greater curvature of the stomach which corresponded in its musculature to the lesser curvature at the seat of the ulcer is often permanently crippled by the ulcer, and that this condition was not overcome by the excision of the ulcer. A considerable percentage of our cases of ulcer of the lesser curvature in which excision had been done later required gastro-enterostomy and this operation is now performed at the time the excision is made. Two deaths have occurred after excision of a simple ulcer of the stomach, from continuous hemorrhage coming on in the second week. The first week following the excision the patients did well; in the second week hemorrhage into the stomach appeared, at first not serious, but gradually becoming severe. As a last resort in each case, gastro-enterostomy was done but without avail. It was shown at postmortem that the bleeding did not come from definite vessels. The mucosa of the stomach had failed to unite and had widely retracted, leaving the muscular coat exposed in the lumen of the stomach, and this was the source of the oozing blood.

Following these two unfortunate results, Balfour[12] (Figs. 2 and 3) began the use of the actual cautery to destroy the ulcer. His method is as follows: The peritoneal and muscular coats are dissected back from the ulcer in the shape of a flap. Then the Paquelin heated to a dull red (just hot enough so that it will not stick) is pushed through the ulcer, gradually heating the entire calloused area. The cautery opening is closed with chromic catgut and interrupted silk, the flap of peritoneal and omental tissues replaced and, finally, gastro-enterostomy is performed. Experiments which Balfour and Mann conducted on dogs showed that the cautery sealed the gastric mucosa to the muscular tissues and that the scar left was almost imperceptible.

12. Balfour, Donald C.: Treatment by Cautery of Gastric Ulcer, Surg., Gynec. and Obst., 1914, xix, 528.

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Experience with this method in a very considerable number of cases has steadily given good results. When there is suspicion of malignancy, a bit of tissue is excised for microscopic examination before using the cautery. The use of the cautery in these cases, however, destroys the ulcer and the diseased mucosa in its vicinity so thoroughly and coagulates, as shown by Percy, tissues beyond to such an extent that one might expect the method would be as effectual as local excision against early malignant disease. Of course, if malignancy is shown to exist, resection is indicated.

In some cases in our clinic in which the cautery and gastro-enterostomy were combined the pylorus was also blocked to force the food out of the gastro-enterostomy opening. The results have been excellent in either case and blocking the pylorus has not seemed to have added anything of value to the operation.

LARGE ULCERS OF THE BODY OF THE STOMACH

Large ulcers occupying the body of the stomach, when the callus and ulcer are too large for the cautery operation of Balfour,[12] are best treated by the sleeve resection, that is, the removal of a segment of the stomach including the ulcer, and an end-to-end anastomosis of the two fragments. This shortens the stomach considerably but gives an excellent permanent result. Just why this operation, in which the corresponding part of the greater curvature is removed at the time the ulcer is excised, should leave a stomach with good motility while excision of the ulcer without removal of the segment of the greater curvature of the stomach leaves it with poor motility is an interesting conjecture.

The most serious ulcers are those of the body of the stomach involving the posterior wall. These ulcers are usually of large size and often involve the pancreas. At times there is an ulcer with a foul crater of considerable size containing food remnants and in which it is extremely difficult to tell whether or not malignant

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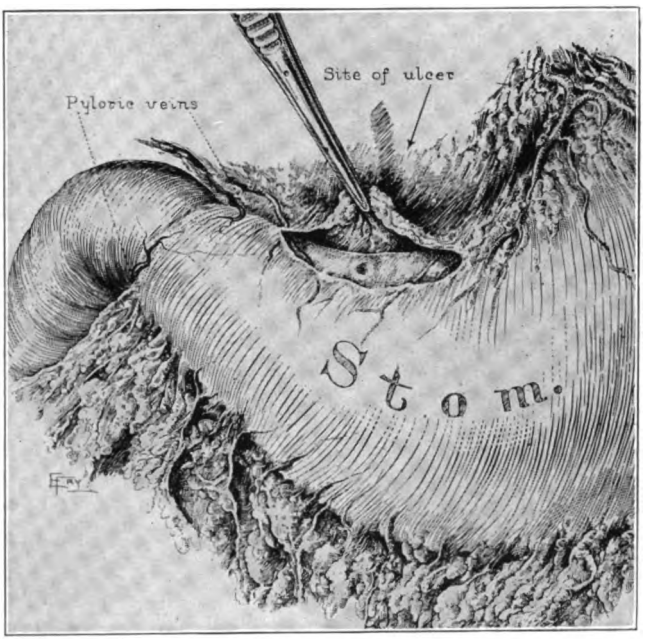

Fig. 1.—Musculoperitoneal flap with gastrohepatic omentum and adhesions raised, exposing the ulcer. Note pyloric veins.

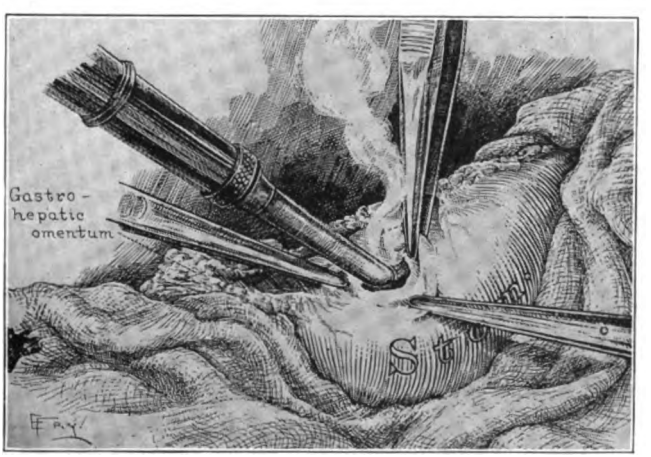

Fig. 2.—Excision of the ulcer by means of the Paquelin cautery.

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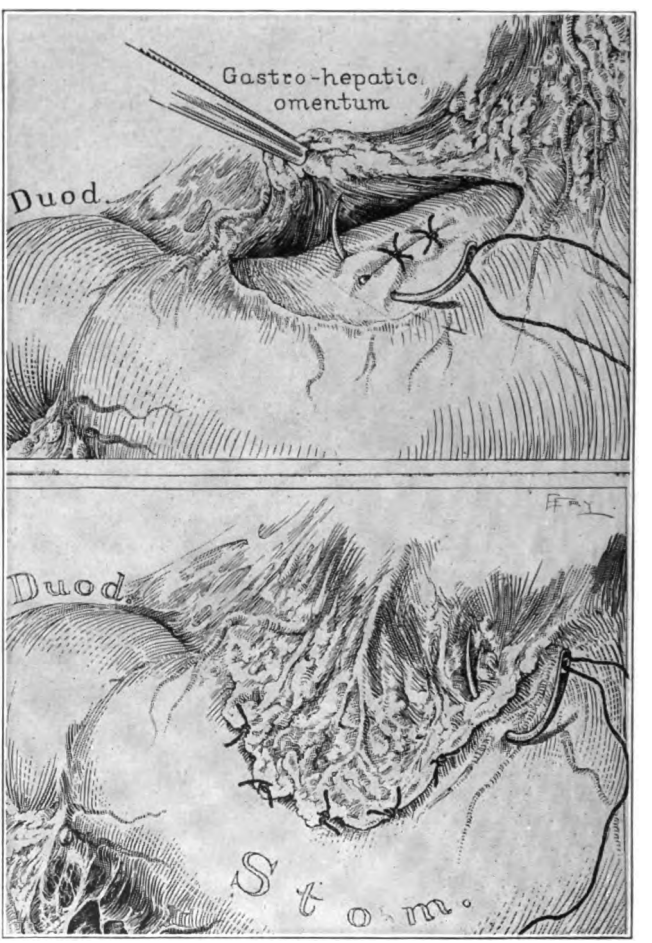

Fig. 3.—Upper figure shows closure of the gastric opening with chromic catgut and interrupted silk sutures. The lower figure shows the flap reapplied.

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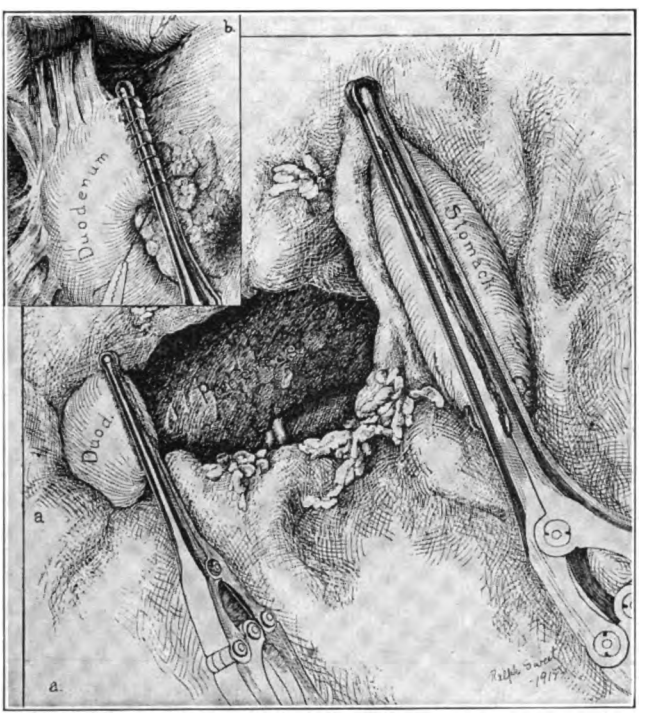

Fig. 4.—Pyloric half of stomach removed; (*a*), ends in crushing clamps; (*b*), sutures placed for closing ends of duodenum.

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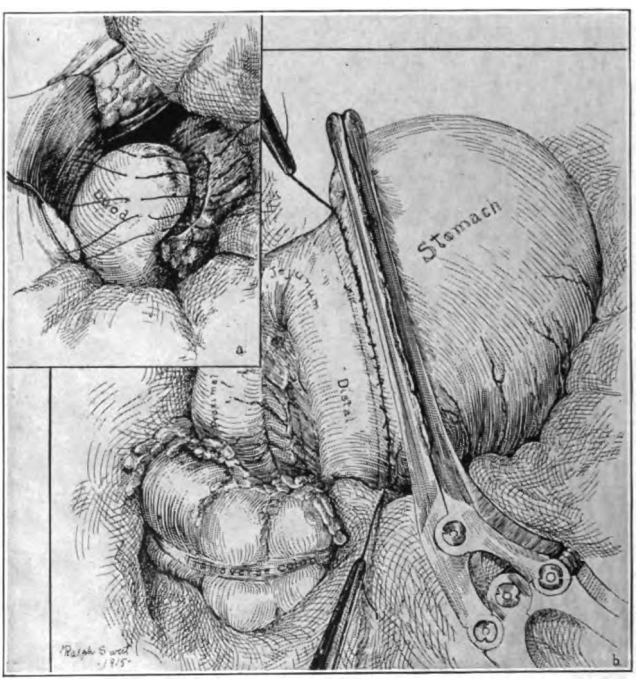

Fig. 5. — (*a*) Sutures in position for final closure of duodenum; *b*, jejunum, close to its origin, brought through an opening made in transverse mesocolon and sutured with interrupted silk sutures to posterior wall of stomach. Dotted line along jejunum shows proposed incision for gastro-intestinal anastomosis. Crushing clamp to be removed to open up gastric cavity for the anastomosis.

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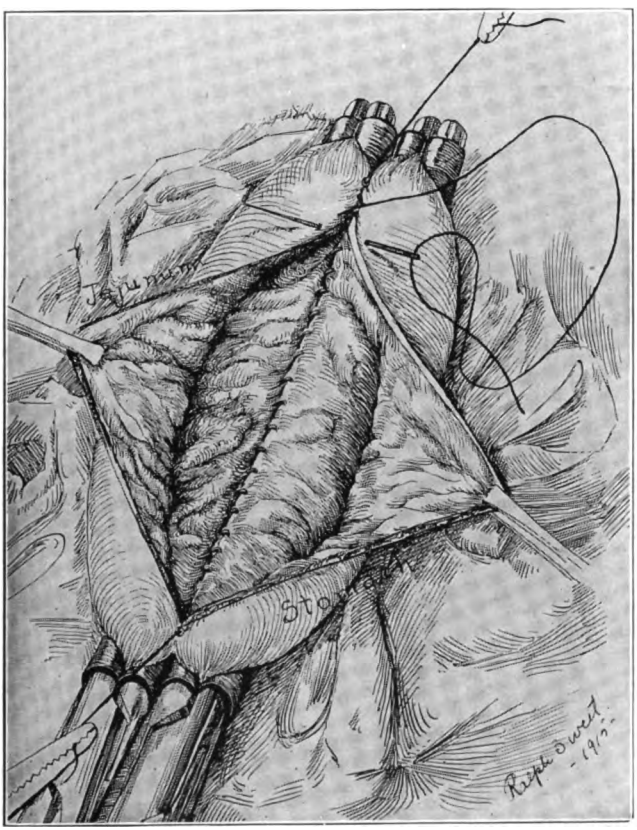

Fig. 6.—Entire end of stomach anastomosed to jejunum posteriorly with interrupted silk and a through-and-through continuous catgut suture which is being continued on to anterior surface.

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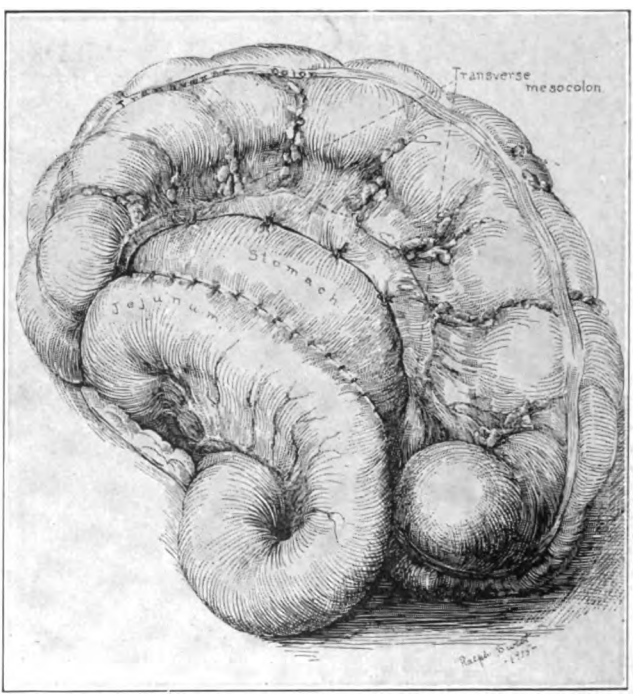

Fig. 7.—Operation completed and end of stomach drawn completely through opening in transverse mesocolon. Margin of opening sutured to gastric wall.

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disease is present. In a general way it can be said that where the actual crater of the ulcer is larger than a silver dime the majority of gastric ulcers will prove to be undergoing malignant change. On the posterior wall of the fundus of the stomach this is not so generally true, for, while many of these ulcers are malignant, some extensive ulcers are benign. For such ulcers, if not too large, the transgastric operation[13] will be found satisfactory. The anterior wall of the stomach is opened, the ulcer excised from within the stomach and the gap sutured from within. The base of the ulcer may be pancreatic tissue; if so, it can be shaved off with a sharp knife until all the exposed part of the callus has been removed, or it may be destroyed with the acutal cautery. If it is possible to gain access to the posterior wall of the stomach, a few musculoperitoneal sutures may be placed to protect the sutures applied from within the gastric cavity, but experience has shown that these are not essential. We have, however, taken the precaution to carry a strip of folded rubber tissue to the pancreatic lesion after covering it with omental grafts. As none of these cases have had any discharge following such drainage, it can be looked on as unnecessary. I am convinced, however, that the more extensive ulcers in this situation are better treated by radical removal of the entire distal end of the stomach including the ulcerated and contractured area, and then the end of the gastric pouch anastomosed directly into the side of the jejunum. This furnishes perfect drainage, gets rid of the entire acid-forming part of the stomach, and insures the patient against recurrence. Comparatively few cases are sufficiently serious to warrant so extreme a procedure, but in several instances, after the failure of less radical means to give relief, and especially in the presence of secondary jejunal ulcers, I have adopted this plan with great satisfaction.

13. Mayo, W. J.: Transgastric Excision of Calloused Ulcer of the Posterior Wall of the Body of the Stomach, Ann. Surg., 1910, lii, 797.

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HOUR-GLASS STOMACH

The hour-glass stomach, if a single loculus, may be treated by gastrogastrostomy after the Watson method or by the sleeve resection just described. We have found the results of either of these operations satisfactory. A gastrogastrostomy which is planned in a general way after the Finney gastroduodenostomy will give excellent results. A considerable number of hour-glass stomachs have secondary obstruction in the vicinity of the pylorus, or they are associated with duodenal ulcer. In either case gastro-enterostomy in addition to the treatment of the hour-glass condition is necessary (Figs. 4, 5, 6 and 7). Where several loculi exist, increasing the lumen of each by a plastic operation of the Heinke-Mikulicz type so that they shall be converted into one large cavity, and then making a gastro-enterostomy is most efficient.

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THE RELATION BETWEEN GASTRIC ULCER AND CANCER

A. J. OCHSNER, M.D.
CHICAGO

This subject has been discussed so frequently and so thoroughly, especially since the attention of the surgical world was again directed toward its importance by the classical address of President Rodman[1] made before this association, that it would seem useless to bring this feature into discussion again were it not for the fact that its importance from the point of view of prophylaxis and the bearing its consideration by the practical surgeon has on prognosis must be appreciated in order to decrease the percentage of mortality from cancer of the stomach, which now, according to Dowd, equals nearly one third of all deaths caused by cancer in the entire body.

Regarding the frequency with which cancer is found in patients giving a history of ulcer, authorities differ so widely that, for the reasons for this great difference, one must look to the manner of taking histories in these cases and to the values placed on certain symptoms. Smithies[2] gives a series of 712 cases in which 61 per cent. belonged to a group which gave histories of ulcer.

Only a few months earlier F. Friedenwald published a careful study of 1,000 cases[3] in which he gave 7 per cent. of cases with a direct history of former ulcer

1. Rodman, W. L.: Excision of the Ulcer-Bearing Area in Gastric Ulcer, THE JOURNAL A. M. A., Sept. 17, 1904, p. 801.
2. Smithies, Frank: Symptoms and Signs of Gastric Cancer, THE JOURNAL A. M. A., Feb. 20, 1915, p. 643.
3. Friedenwald, J.: Clinical Study of One Thousand Cases of Cancer of Stomach, Am. Jour. Med. Sc., November, 1914.

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and stated definitely that, in this series of cases, in only 23 per cent. could the cancer have developed on an ulcer.

It is necessary only to select the report of these two well-known, conscientious, capable and reliable authors to prove that an analysis of case reports cannot give us data of great value on this subject, not because of probable unreliability, but because one could have the same house officers write history after history of patients who had definite symptoms of ulcer in the past without recording the facts on which one could make a diagnosis. One can make an analysis which will have value only when the histories of all cases under consideration have been written by men who have followed the cases in which a diagnosis of gastric ulcer has been made into the operation room where the diagnosis has been proved or disproved. I have personally tested this phase many times and am convinced that every careful clinician who will direct his attention on this point will agree with me on making a series of tests. To my mind, the positive statements which Graham[4] made on the relation between ulcer and cancer years ago were very significant because he followed all of his cases into the operating room and all the specimens obtained into the pathologic laboratory.

In the personal experience of each individual surgeon who has specialized more or less in the treatment of diseases of the stomach, one finds that at first many cases must have escaped detection, while, according to Cabot, is only 72 per cent. of the cases admitted to the hospital with a diagnosis of cancer of the stomach was cancer found at the necropsy. It is true that when one's attention has been once directed thoroughly to the symptomatology of gastric ulcer, careful attention to the history alone gives a very reliable basis for a positive diagnosis. It is also true that, in clinics in

4. Graham, C.: Cancer of the Stomach, Boston Med. and Surg. Jour., Nov. 12, 1908, p. 635.

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which many cases of gastric ulcer come for operation, even the younger assistants learn to recognize the symptomatology, but the histories one finds in the hospitals which were written only a few years ago are quite free from the appreciation of these symptoms.

On the pathologic side the evidence is still more misleading, because until very recently but a very small proportion of the cases in which cancers were removed surgically from the stomach came early enough to enable the pathologist to recognize the presence of an ulcer margin on which the cancer had been engrafted. It is of course quite improper from a scientific point of view to give any value to the observation that in advanced cancer no trace of ulcer can be found, because it is the development of the cancer from a minute beginning to its ultimate growth which must necessarily remove every evidence of the existence of the ulcer which was present at the time of the first appearance of the cancer.

In order, then, to have a reasonable basis for our judgment, we must consider only specimens in which the cancer cannot have destroyed the evidence of ulcer at any time before the specimen was obtained, in case this was present as a lesion on which the cancer was primarily planted.

Thomson and Graham[5] made an interesting study on "Fibromatosis of the Stomach and Its Relationships to Ulcer and to Cancer," which aids greatly in clearing up some of the evidence which has generally been misconstrued. It seems clear from their exposition that "the ulcer which is complicated with fibromatosis may also become the starting point of cancer."

Rodman, Mayo and others have constantly directed our attention to the significant fact that the ulcer-bearing areas of the stomach are also the areas most commonly occupied by cancer. This has led to much

5. Thomson, A., and Graham, J. M.: Ann. Surg., 1913, lviii, 10.

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discussion in two directions. On the one side, it has been claimed that, because of this fact, all ulcers should be excised at the time of operation in order to remove the possibility of the development of a cancer on the base of an ulcer. On the other hand, the wisdom of this position has been doubted because of the observation of Kocher, who found "no carcinoma in eighty patients one to twenty-two years after operation for ulcer," [6] and this fact has been construed to mean that cancer would not have developed in any of these ulcers had they not been operated on, while in fact it means that, these ulcers being cured before cancerous infection had taken place, the exciting cause was permanently removed.

Other observers have followed large numbers of cases with the same result, and some of them have concluded from this that there could be no definite causal relation between ulcer and cancer. Again, the fact that cancer occurs only very rarely in the duodenum, while it occurs so frequently near this point in the contiguous mucosa of the stomach, has been used as an argument against the causal relation of ulcer and cancer. If we bear in mind, however, the fact that the conditions under which these two forms of ulcers exist are entirely different, notwithstanding their proximity in location, the foregoing argument loses all of its force. On the side of the stomach there is a great deal of trauma because of the violent action of the muscles of the pyloric end. This causes a great increase in the amount of irritation, and we know from the study of cancer in other parts of the body that there is a direct causal relation between irritation and the formation of cancer. These facts were all brought out so clearly by Coffey[7] that they need not be repeated here. Moreover, intestinal contents are held in contact with the ulcerated surface

6. Quoted from Murphy's Clinics, April, 1914.
7. Coffey, R. C.: Cancer of the Gastro-Intestinal Tract, Northwest Med., May, 1908, p. 165.

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on the gastric side of the pyloric sphincter for a considerable period of time each day, while on the duodenal side these contents are forced on immediately on entering the duodenum. This has been demonstrated many times by means of the use of a bismuth meal and Roentgen-ray screening. Recent observations, especially those of Abelmann and Carl Beck, seem to point forcibly toward the possibility of inoculation with cancer virus, quite different from our former conception that cancer is amenable to transplantation but not to infection. That transplantation of cancer from points in the upper portion of the alimentary tract to the stomach is possible has been shown by the remarkable studies of Fütterer and is supported by analogy in other parts of the body.

We find here, then, on one side of the pyloric sphincter conditions which are favorable to cancer inoculation, while on the other side these conditions are absent, the only similar conditions being the defect in protection against inoculation because of the lesion in the mucous membrane.

Whether the presence of an acid medium on the gastric side and an alkaline medium on the duodenal side has any relation to the cancer infection cannot be determined at the present time, although the rareness of occurrence of cancer in the liver, which acts as a filter for all of the blood, would indicate that there may be inhibitory qualities in the bile.

Whenever experimental work shall have advanced sufficiently to convince pathologists generally that cancer is due to an infection, of which I am fully convinced not only from clinical observation and the careful study of many hundreds of human specimens but also from a study of the experimental work of Abelmann and Beck, the causal relation between ulcer and cancer of the stomach will be as clear as the relation between ordinary wounds and pus infection is today.

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The observation that ulcer does not commonly result in cancer after relief from operation for the former condition would indicate that the ulcer simply acts as an opening through which an infection of carcinoma can conveniently enter, just as an abrasion on the skin will permit the entrance of the germs causing acute infections, and that so soon as the ulcer has healed the patient is again fairly protected against cancer infection.

The experiments of Rosenow seem to show a definite relation between streptococci infection with a definite selective quality and the formation of gastric ulcer. It may be possible in time to eliminate the formation of these ulcers by preventing the introduction of these streptococci. The observations of Gaylord, Marine and Marshall concerning the production of cancer in fish with food containing fecal excrement seems worthy of consideration in connection with this subject.

There can be no doubt but that much unclean material could easily be eliminated from our food, or, if it is present in the food in such a form that it cannot be eliminated, it can at least be sterilized by careful cooking. I refer especially to uncooked vegetables which are grown in soil filled with manure.

One of the most convincing arguments, from the statistician's point of view, in favor of the theory that cancer of the stomach usually develops on an ulcer is based on the fact that there is the same relative preponderance of cancer in men over women that we find in regard to ulcer, the condition being nearly twice as common in the former as in the latter. Were there not a definite causal relation between ulcer and cancer, it does not seem reasonable that this proportion could be identical in the two sexes.

During the past ten years I have personally studied all cases of cancer of the stomach removed in our clinic with a view of determining whether its beginning

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was in the margin of an ulcer, and in all of the cases not too far advanced for reliable observation I have been able to find evidence of the previous existence of an ulcer. In the late cases neither positive nor negative evidence could be found.

Regarding the evidence from the history, from previous diagnosis from those treating the case and from laboratory findings I have found that one who is thoroughly careful in his search for all facts which have a bearing on the fact that cancers are implanted on ulcers can always elicit from the patient by careful cross-examination, a sufficient amount of evidence in the history to support this position, while if one must depend on the facts put down in the ordinary history written by house officers whose attention is not centered on this feature, one will be disappointed in his search for typical ulcer symptoms. It would, of course, be improper to deny the presence of an ulcer on the evidence found in histories of cases of gastric cancer written by assistants whose attention had not been directed to the importance of carefully searching for relevant facts, although these histories may be quite bare of any evidence which would establish the presence of ulcer beyond a doubt.

In order to obtain statistics with value in this direction we must consequently give especial attention in the future to this feature. It is significant that most surgeons with a very large experience in the operative treatment of gastric ulcer and cancer seem convinced of the positive causal relation of the two conditions. This has again been brought out by Moynihan;[8] he fully agrees with the views of W. J. Mayo, whose enormous experience alone would be sufficient to establish the causal relation between ulcer and cancer beyond a doubt.

Coming to the practical end of the subject, it seems clear that, if cancer of the stomach is usually implanted

8. Moynihan: Abdominal Operations, Ed. 3, i, 287.

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on ulcer, we are in position to reduce the mortality from this cause to a very marked extent, first, by eliminating the various causes of gastric ulcer so far as possible; second, by securing the permanent healing of these ulcers when they first appear, primarily by making an early diagnosis and instituting carefully regulated long-continued dietetic treatment and hygiene; secondarily by surgical treatment; in the third place by preventing the use of unclean, uncooked foods, and in the fourth place by excising all suspicious ulcers.

My observations seem to warrant the following conclusions:

1. In all of the recent or early cancers we have encountered, the growth was located in the edge of an ulcer.

2. By careful study of the history of late cancer, in which the original ulcer had, of course, been obliterated by the growth, it was possible to elicit a previous ulcer history.

3. In studying the development of cancers in other parts of the body we find that a point is usually selected which has been subjected to long-continued irritation, as in the lip, face, rectum or uterus.

4. The fact that there are so few cancers of the duodenum as compared to cancer of the stomach can be explained by the fact that, while there is stasis in the stomach, there is none in the duodenum. In other words, while food containing the cancer germs will remain in contact with the ulcer of the stomach sufficiently long to permit the germs to become implanted, this is not the case in the duodenum.

5. It is possible that these germs may require an acid medium to stimulate them to attack the tissues.

6. It is relatively an easy matter to overlook the history of a previous gastric ulcer, because in the absence of severe hyperacidity the pain in these cases

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is frequently not sufficient to be remembered through the great distress from which the patient suffers after the cancer has developed.

7. In our experience a large majority of these patients have habitually eaten large quantities of food which was certain to be infected with manure, such as lettuce, celery, radishes, etc., so the introduction of the cancer germ into the open wound of the ulcer could easily be explained.

8. These gastric ulcers are of such long duration that the focus of irritation might readily serve to locate cancer germs which might have entered the circulation through some other portal.

9. This does not indicate that every patient who has ulcer of the stomach will ultimately have cancer, any more than that every soldier going to war will be shot, but it shows the wisdom of closing this opening for the entrance of cancer by curing the ulcer early and permanently.

10. Much attention should be given to the early history of these cases, and to the prevention of feeding these patients with unclean, uncooked foods.

2106 Sedgwick Street.

ABSTRACT OF DISCUSSION

ON PAPERS OF DRS. MAYO AND OCHSNER

DR. EMMET RIXFORD, San Francisco: These papers have brought together the knowledge of the world on the subject of gastric ulcer and gastric cancer, together with the results of experience of Drs. Mayo and Ochsner. There has not been in the minds of most of us much doubt as to the relation of gastric ulcer to gastric cancer since the paper of Dr. Rodman (Trans. Am. Surg. Assn., 1908, xxvi, 189) which showed a definite sequence of the one on the other, and it is interesting to learn after these years that there has been very little added to what Dr. Rodman then said. In regard to etiology, little has been produced that is of interest, and we have not gone far beyond the point reached long ago that cancer develops at points of irritation. We are as far as ever from finding the organism, if there is such an organism. In the present state of knowledge the most that can be done practically in the prevention of cancer is to lessen the effects

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of chronic irritation on such lines as were clearly laid down by Drs. Mayo and Ochsner. We know what to do with the well-developed cancer of the stomach, and we also know full well what is the outcome. The indications for abdominal section are so much wider in the development of modern surgery that we see stomach conditions at a much earlier date; we are therefore put to it to make a differential diagnosis between ulcer and cancer in the operating room when the abdomen is opened. We do not always have a competent pathologist with us, and sometimes we yield to temptation to operate in some other place than our own operating room and cannot take the pathologist along. Not always is cancer found, when present, even when the pathologist has the best opportunity to make his microscopic examination. I recall a gastric ulcer with secondary carcinoma implanted on it (at least that was my operative diagnosis) and I made a wide excision and sent the tissue to the pathologist for examination. He found no carcinoma and I regretted having done an unnecessarily extensive resection. Later the patient returned with definite carcinoma whereupon the pathologist in reexamining the original specimen, making almost serial sections, found small areas of carcinoma. If, however, we can have a microscopic examination by a competent pathologist at the time of operation, many errrors will be eliminated and a more logical and more radical operative procedure inaugurated.

Dr. William L. Rodman, Philadelphia: For fifteen years the question has, to me, been a plain one. Gastric ulcers demand radical treatment; for, even if we waive the question as to whether or not benign ulcers of the stomach tend to become malignant, there is enough evidence to justify radical treatment in every case of gastric ulcer where the lesion is mobile or can be mobilized. Even though you ignore the liability to cancer, I insist that excision should be practiced because the danger in excision is only one-third that from perforation, and only one-half the danger from hemorrhage, to say nothing of such complications as subphrenic abscess, hour-glass stomach and conditions other than cancer. But more important than all these is malignant transformation. In 1839 Cruveilhier, in 1848 Dittrich and in 1849 Rokitansky and men of their type emphasized the danger of malignant transformation, and it was reading these authors that made me, in 1900, insist on excision or radical treatment of gastric ulcer. Sir Berkeley Moynihan, when here in 1903, said to me: "Rodman, you are wrong; the estimate of Hauser that 6 per cent. of carcinomas are preceded by ulcer, is large enough and would more than include ulcers undergoing malignant transformation." When he came back in 1908, in a paper read before the American Surgical Association, he said that, after careful examination and investigation of his cases, more than 72 per cent. were

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undoubtedly preceded by ulcer. Mayo Robson, as well, has changed his views, now advocating excision of the ulcer-bearing area on account of 59 per cent. of his gastric cases having been preceded by ulcer. The Rochester Clinic shows a much larger percentage and W. J. Mayo further says that no one can from inspection and palpation tell definitely whether a lesion is benign, and that many cases supposed to be benign subsequently were found to have been malignant. While it is true that ulcers at the pyloric end of the stomach are particularly prone to undergo malignant change, and that ulcers in the larger and more expanded four fifths of the stomach are not so likely to become malignant, too much has been said on this subject, because there are cases on record in which ulcers in the larger portion have undergone malignancy. Cackovic reported such a case, so have I, and even if there were none, and we still ignored the possibility of malignancy, it is unwise to allow these ulcers to perforate, because that part of the stomach is always movable, does not form adhesions readily, extravasation quickly occurs, and such patients will not be rescued after perforation. The danger of perforation and hemorrhage from such ulcers is more than sufficient to demand radical treatment.

It is naturally gratifying to me to see the marked change which has taken place in the surgery of ulcer. When I first suggested excision of ulcer in the body of the stomach and pylorectomy for those at the pylorus (1900), it was considered much too radical and gastro-enterostomy was the operation almost universally practiced. The latter, as I then pointed out, was entirely inadequate and is generally so recognized, and excision and pylorectomy have become the operations of choice with those having the greatest experience in gastric surgery.

Dr. W. I. Terry, San Francisco: It seems to me that the question of carcinoma of the stomach following ulcer is a determined one. The frequency with which it occurs will be determined after the lapse of many years and particularly after a careful analysis of many cases which have been subjected to operation in the large clinics. The follow-up work of Dr. Peck throws light on several questions in the diagnosis of these conditions of the stomach, and when followed up thirty years from now we will have something very definite on which to base our statements. In the meantime, however, we have to do the best we can by these patients and treat them all as suspected malignancy and do the radical work by the Rodman, Coffey, Balfour or other approved method and then we shall have done our duty to the best of our knowledge.

Dr. Miles F. Porter, Fort Wayne, Ind.: To my mind the question of the etiologic relationship existing between ulcer and cancer of the stomach is a settled one, but as to what

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it is I do not think it is certain. Are we warranted in concluding that because gastric ulcer predisposes to carcinoma, that therefore the carcinoma is probably produced by a germ and that this is the only explanation? Recent experiments have shown that the injection of raw sterilized albumin produces carcinoma, so, therefore, I think we should wait for more evidence before deciding this question. The practical point, however, remains the same. The same process devised for the killing of the germ by Dr. Ochsner will also cook the raw albumin. Gastric ulcerations allow the passage of raw albumin into the general circulation. It has been proved that animals, sensitized by the injection of raw albumin, are prone to cancer. I bring this point up for the purpose of putting a question worthy of further study. Dr. Rixford said that sometimes we operate in these cases when we have no pathologist present. Now I want to say that I think I have no business to operate when I have no pathologist present, and I say this with the kindliest sentiment in the world.

Dr. A. E. Rockey, Portland, Ore.: I want to say a few words in reference to the etiology of carcinoma in its relation to ulcer. In a paper presented at the recent meeting of the Pan American Medical Congress, I advanced the hypothesis that carcinoma is not due to any single external cause, but that it is produced by a defensive reaction of the cells to a great variety of irritations. The result of any sufficient irritation to the cells, whether it be microbic, traumatic, radiant, thermic or toxic, is the death of the cells. The body is a community of individuals, which we call cells, that have both an individual existence, and a community relation with each other. Embryonal cells are the same in character until after their division into the germinal layers of the ectoblast and endoblast. In adult tissues there is a normal repulsion to admixture of the cells. When any irritation falls short of the death of the cells, there is produced a stimulation, which is defensive in character, and which is followed by an active karyokinesis to increase the number of the cells. The more rapid this defensive karyokinesis, when growth is closely balanced with destruction, the more nearly do the cells approach the embryonal type. There are fortunately only certain conditions in which this causes carcinoma. Irritation produces the same reaction in the mesoblastic tissue as it does in the epiblastic tissue, and to form cancer the basement membrane must be destroyed. In their common struggle for existence against any irritation, when growth and destruction are closely balanced, the cells lose their normal antagonism for each other, become irregular in their mitosis and the young cells from the epiblast become engulfed in those from the mesoblast, and cancer is begun. Being thus submerged, they cannot attain either normal anatomic per-

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fection or physiologic activity. They retain the excessive karyokinetic tendencies of their immediate progenitors, and expend their energy in a reproduction that is both immature and irregular. Deflected from their proper place in the epiblastic layer, they infiltrate the mesoblastic tissue, which they destroy by pressure, and enter the lymphatics and form metastases. Dr. Ochsner has intimated that proof will presently be forthcoming of the specific microbic origin of cancer. What single microbic cause can we find suggested in cancer, where the source of irritation is so varied as that which we find in pipe smokers' cancer of the lip, betel nut chewers' cancer of the mouth, cancer of the breast following a single trauma, cancer of the abdominal wall in the natives of Thibet, who wear small charcoal stoves to keep the hands and body warm, or in Roentgen-ray cancer of the hands? We have searched too far, and have overlooked the very evident fact that a defensive reaction of the tissue cells to irritation that threatens their destruction is the cause of that irregular growth and displacement which we call carcinoma.

Dr. J. Chris. O'Day, Portland, Ore.: When I was an understudy of Miles F. Porter he taught me to regard cancer as the manifestation of epithelium running wild. I still believe it. If the theory of Dr. Ochsner is correct I would ask how the fecal matter gets to the mammae or the uterus, for do we not have cancer there? As to gastro-enterostomy in the presence of gastric ulcer, I have made it a rule for several years that when a gastro-enterostomy will short circuit the chyme from the ulcerated area it is the operation of choice. If it will not do this it is not the operation to do. When the ulcer is in the region of the pylorus, the beautiful results one obtains by this operation are known, but when the ulcer is higher, and the gastro-enterostomy will not short circuit the stream—in other words, the ulcerated area is still exposed to the irritation—it will do no good. As to Dr. Mayo's operation of opening the anterior wall and attacking the ulcer on the posterior wall from within, it seems to me there is something about that operation which he did not tell us. Personally I would be afraid to attempt it because my technic is such that unless I include peritoneum in my needle work, I would feel in danger. He did not tell us how he applied his sutures. From the illustrations it would seem that if the sutures yielded to the gastric juice before union had been firm, gaping or leakage might occur.

Dr. C. G. Levison, San Francisco: The cure of cancer is not going to come from the surgeon, it must come from the physician. There is one point that must be accomplished before cancer can be cured and that is that we cannot succeed in getting good statistics until the cases are seen in their incipiency, which means that by the time gastric ulcer has

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been referred to the surgeon for operation cancer is already present in the advanced stage.

A case in point will illustrate this. A friend had returned from Europe with all of the manifestations and the cachexia of cancer of the stomach. He was seen at the club and I remarked to a mutual friend, I will tell you what will happen to this patient; he will be treated by the family physician who after six months will refer him to the surgeon for operation; at the operation the patient will be found to have an inoperable cancer of the stomach. After six months we were called in to operate and when the abdomen was opened an inoperable carcinoma of the stomach was found. Until these conditions have changed there can be no improvement in our statistics as far as ultimate cure is concerned. The development of cancer of the breast and stomach can be averted by operating in benign conditions, just as the gangrenous appendix has almost disappeared as the result of the interval operation.

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MYOSITIS OSSIFICANS TRAUMATICA

OSCAR M. SHERE, M.D.
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DENVER

The formation of bony tissue within muscle after a single injury cannot be regarded as a recent discovery, nor is it as rare a condition as some may be inclined to believe. In reviewing the literature on this subject one is rather surprised to find reports of a great number of cases. The reason, however, for the accepted rarity of this peculiar pathologic condition is to be ascribed to the fact that most of the essays devoted to this subject deal with a great number of distinct clinical processes grouped under one general head, "myositis ossificans." When one makes the attempt to segregate the different forms of this peculiar condition from the literature, one is led into confusion and misunderstanding, being confronted with a single term covering diverse clinical conditions which are as indefinite and mystifying as the pathology of the disease is in itself.

At the outset, therefore, I desire to make this point clear, that in this brief discourse I shall aim to direct attention to that morbid process wherein bony tissue finds lodgment within muscular structures, such process occurring after a single closed injury to the region thus involved. I believe that the term "myositis ossificans traumatica" should embody the foregoing, and no other similar process, though of the same category.

It is only the allotment of a distinct entity to this particular form of the disease that will enable us to bring about a clearer understanding of the etiology, which in turn will insure a more intelligent treatment

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of the affection, and consequently many an unnecessary amputation will be obviated.

Though two other cases have come under my observation, I deem best to introduce the subject by citing this individual case which formed the inspiration of this paper:

History.—A. C., man, aged 51, seen by me Dec. 5, 1913, with negative personal and family history, had always been in excellent health. The day previous, while engaged in unloading freight from a car onto a truck, the end of the latter accidentally struck his right thigh. The thigh, though severely bruised, did not incapacitate him, and he continued his work for several hours. He then walked home, a distance of over 2 miles. The next morning he noticed considerable swelling and ecchymosis, as well as pain which became exaggerated on motion of the extremity. It is at this stage that he first came under my observation, when the diagnosis of a severe contusion to the lateral aspect of the thigh was made. The treatment instituted consisted of rest in bed with elevation of the injured extremity. Hot fomentations had been constantly applied by the patient previous to my visit, and these were ordered to be continued. The patient followed this line of treatment for several days, when the swelling and ecchymosis had nearly disappeared; pain, however, still persisted when an endeavor was made to move the limb. These symptoms continued for about three weeks after the occurrence of the injury, when the patient again consulted me, at which time a careful examination disclosed a swelling of fusiform outline and about 3 inches in length over the external aspect of the middle third of the thigh (Fig. 1). The superjacent skin was still somewhat ecchymotic; otherwise there was no swelling. The "lump" was extremely tender on palpitation. Flexion of the knee beyond one fourth the normal range caused rather severe pain. The patient's general condition, however, remained unimpaired. A roentgenogram was taken the next day by Dr. S. B. Childs, whose report is herewith quoted: About the middle of the left femur on its outer aspect is a slightly irregular area of bony structure. (The margin of this area is traced by dots, as it is impossible to reproduce this shadow so that it may be clearly seen either on a lantern slide or print.) This mass shows distinctly both in the anteroposterior and the lateral view. Diagnosis: Bony growth springing from the shaft of the femur carrying the periosteum ahead of it.

In view of the outlined clinical as well as Roentgen findings, the diagnosis inclined toward periosteal sarcoma with a probability of myositis ossificans. An exploratory operation was advised, to which the patient readily consented.

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Operation.—Jan. 7, 1914, about five weeks after the original injury, under ether anesthesia, an incision 6 inches in length was made over the lateral aspect of the thigh, embracing the most prominent part of the tumor. On cutting through the fascia lata and separating bluntly the muscular planes of the vastus lateralis, the handle of the knife encountered masses of bony deposit within that and underlying muscular structures until the thickened periosteum covering the middle portion of the femur was reached. When the latter was incised, the external and anterior surface of the femur was seen to be covered by cancellous bony deposit, not differing in any way from that developed on the surface of the long bones in cases of osteoperiostitis. This deposit was easily scraped off the normal shaft of the bone with a blunt curet. The section of the vastus muscle which was infiltrated with bony tissue was excised. A small rubber tube drain was inserted down to the normal bone. The fascia was sutured with chromicized gut, and the skin suture completed the operation. The drain was left in for twenty-eight days, when the wound was completely healed, no secondary infection having supervened. The entire extremity appearing normal, the patient was permitted to leave his bed and cautiously commence the use of the affected extremity. During the next three months the patient gradually resumed normal life and exercise, and at the end of this period was suffering no disability, except an occasional twinge at the site of operation. He soon afterward resumed his usual vocation, that of a freight stacker, which he follows to this day. The scrapings of bone from the shaft of the femur which were saved, together with the portion of the vastus muscle removed at the operation, were submitted to Dr. Philip Hillkowitz for pathologic diagnosis, who, after a very careful examination, made the following report: Pathologic specimen No. 878. Microscopic examination of sections from tissue removed from Mr. A. C. reveal islands and beams of bony structure surrounded by dense fibers of connective tissue which are situated in the midst of the muscle bundles. Instead of the connective tissue, areas of cartilage are frequently found near the islands of bone. Occasionally collections of spindle-shaped cells are situated between neighboring beams of bone—cells that resemble if they are not identical with fibroblasts. The picture is that of the pathologic condition seen in so-called myositis ossificans (Figs. 2, 3 and 4).

In reviewing this clinical history, in conjunction with the Roentgen as well as microscopic findings, one cannot help but be impressed with the existing analogy between traumatic myositis ossificans and that of traumatic sarcoma.

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To begin with, we are bound to recognize that in the two conditions just named we have a new growth of bony tissue which has been stimulated by a closed injury. If we accept White's definition that a neoplasm is "an abnormal mass of cells, tissues or organs . . . resembling those normally present but arranged atypically, which grows at the expense of the organism without subserving any useful function," how are we to proceed to exclude the pathologic process found in myositis ossificans as shown by the foregoing microscopic findings from the category of true neoplasms, and if so how does it differ from osteosarcoma?

The causative factor in both instances is a single closed injury. The continuity between the time of injury and tumor formation is alike in the two conditions. The morbid process arises on the exact site where an injury has previously taken place. In the two instances, the growth is rather rapid, which is also true of its predisposition for the earlier periods of life.

Again, in the literature we find cases reported in which the original diagnosis of myositis ossificans was made by a competent pathologist at the exploratory operation; such cases having been previously diagnosed by expert roentgenologists as belonging to that class, and after a lapse of several months, in some cases two or three years, these patients presented so-called "recurrences," and subsequent operations disclosed these growths to be osteosarcomas.

To emphasize this point still farther, I quote from Coley's article on this subject:

> It is stated that the diagnosis of subperiosteal sarcoma had been made in all three of Finney's cases. One case operated on twice, recurred, necessitating three operations. Amputation at the hip-joint had been recommended and was about to be performed in one case, when first seen by Finney. In another case quoted by Finney (Whitelock) amputation of the thigh was performed under the mistaken idea that the condition was a periosteal sarcoma.

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Numerous instances of this kind are reported by other observers, but for the sake of brevity they will be omitted from this paper.

Is there or can there be any doubt in any one's mind, that the two conditions are in all probability related? I have experienced in two cases the perplexing problem in which the roentgenologist as well as the pathologist would not commit themselves as to the true nature of the condition, being undecided whether the process was myositis ossificans or sarcoma. Subsequently, however, these cases proved to be myositis ossificans, the proof consisting in the fact that the patients were cured and were free from recurrences after four and two years, respectively. When we bear in mind that the roentgenogram as well as the microscopic picture of the tissue differ but little in the two conditions, we can hardly blame them for their reluctance in making a positive diagnosis (see Figs. 1 and 4, and compare with Figs. 5 and 6). There are some pathologists who assert that all these cases are sarcomas originally, and that soon after the accident a sarcoma develops in the bruised and strained portion of the periosteum, the sarcoma remaining of very slow growth and almost latent for years, when suddenly it lights up and grows with great rapidity. Against this theory, Coley cites the well-known fact that not infrequently benign tumors of the breast, cysts, cystadenomas or fibromas do undergo malignant degeneration and become carcinoma. Likewise he says, chronic inflammatory conditions often undergo similar degeneration in course of time. Old fractures also offer favorable sites for the development of sarcomas.

While considerable difference of opinion has prevailed and still prevails regarding the histogenesis of cancer in general, and notwithstanding the theory of Ribbert, who holds that in all cases of malignancy we must have an embryonic "cancer nest" present, I am

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in full accord with Coley's theory, namely, that certain cases of myositis ossificans will under favorable conditions become true sarcomas.

The question before us, then, is to determine what are the predisposing causes that favor such a transformation. In my endeavor to answer this question, I hope to be able to throw some light on the essential factor in the obscure etiology, namely, trauma of the closed variety.

Before entering, however, into this analysis, permit me to pass in review the chief pathologic characteristics of the structural elements which dominate myositis ossificans as well as that of normal process of repair after injury to periosteum, bone or any structure belonging to the connective tissue variety.

We know that in both processes the cell products are of the connective tissue type; but instead of fibers, as we are apt to picture to ourselves when speaking of this particular type of tissue, these newly formed structures are largely composed of cells wherein the ground substance is much less abundant in proportion to the cellular elements than in normal or adult tissue of that type. The cells of such metaplasms, if I may be permitted to use this term, resemble closely those found in the developing connective tissue of the embryo, or the granulation tissue of inflammation, in which they are known as fibroblasts. These fibroblasts in time will either become true functionating connective tissue cells or they may undergo various metaplastic changes with the resulting formation of either cartilage or bone. In the repair of a wound we have a fibrosis which consists of an increase of these fibers at the spot where the inflammation existed. This, in fact, constitutes the process of normal repair and absorption of an inflamed area (Adami). If, however, the process of inflammation is not combated, then the same fibroblasts, instead of forming the granulation tissue of a healing wound, may and often will form cartilage or bone.

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In consideration of the foregoing facts, it becomes clearly evident that the dominant cell in myositis ossificans is identical with the one found in regenerating tissue following injury. To carry it still farther, we must admit that the same cell also typifies sarcoma.

The significance of these introductory remarks will become apparent when we classify injuries into their proper as well as essential subdivisions, namely, (a) closed and (b) open injuries, or "trauma occulta and trauma aperta."

It is absolutely imperative, when we speak of trauma in relation to myositis ossificans, to emphasize whether the injury is an open or closed one, because the process of repair which subsequently follows, and on which, in my opinion, the genesis of the growth depends, is so vastly different in the two forms named above, although both of them depend on the same cellular element for their growth, as I have clearly shown in the pathologic discourse of this paper.

Is it not rather unique, to say the least, that in over 200 cases of traumatic myositis ossificans which I have collected from the literature, not a single one occurred after an open injury? Is this a mere coincidence or does such an incontrovertible fact furnish us with a probable clue to the solution of this mystifying pathologic process? I am inclined to answer the latter part of this question in the affirmative.

Neither time nor space permits me to even touch on the various theories advanced regarding the pathogenesis of this interesting condition. After a great deal of discussion, the question is as indefinite today as it was in 1740, when the first case of this kind was reported by Freke in the *Philosophical Transactions*. The most generally accepted methods of origin, however, are that (1) a bit of periosteum is torn off at the time of the injury, and, becoming displaced, continues to form bone or that (2) also as a result of trauma, the fibrous connective tissue or even the muscle fibers themselves undergo retrograde changes

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which result in bone-like formation. Against the first accepted theory I offer the experimental fact that the periosteum in itself is not osteogenetic. Murphy says that normal periosteum completely detached from bone and transplanted into muscle tissue bed in the same individual may produce a permanent bony deposit, but only if osteoblasts remain attached to the lower layer of the periosteum. He considers the periosteum to be a limiting membrane. Macewen likewise teaches that the function of the periosteum is to limit the distribution of osteoblasts, thus preventing their migration to the soft tissues. The second theory, though more logical, still does not conform to modern teaching, and is not carried out sufficiently in my opinion. I should also venture to assert my doubt in the statement made that the muscle tissue in itself ever undergoes degeneration.

Histologic study, verified by experimental work, has now definitely established that any new growth arises in a minute circumscribed area in which a progressive proliferation of cells takes place. It must also be remembered that the connective tissue of any neoplasm is partly derived from the preexisting connective tissue of the surroundings, and is partly a new formation. In studying the photomicrographs of the tissue removed from my case, we can readily see that the muscle bundles have undergone but little change, and that the components of the newly formed tissue are fibroblasts, cartilage and bony cells (Figs. 2, 3 and 4).

If I have made myself clear in what I have said above, it necessarily follows that, for certain pathologic reasons, when connective tissue structures are traumatized, the proliferation of fibroblasts or osteoblasts, as the case may be, takes place, and when the injury is a closed one this process of proliferation goes on and the new cells by their migration invade every available space in the surrounding and neighboring tissues until farther restrained by some new

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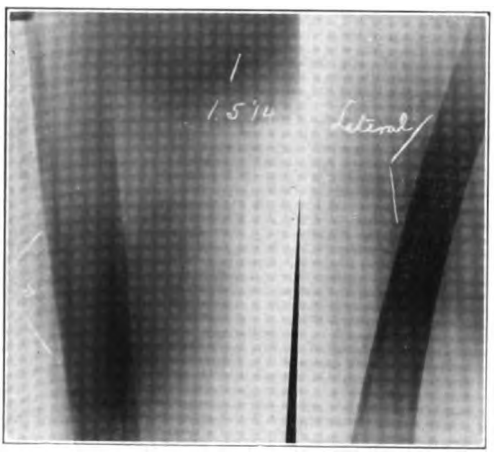

Fig. 1.—About the middle of the left femur is a slightly irregular area of bony structure. This mass is traced on the anteroposterior as well as the lateral view.

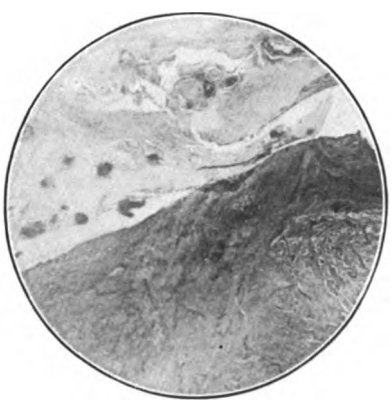

Fig. 2.—Myositis ossificans. This area shows islands and beams of bony structure surrounded by dense fibers of connective tissue which are situated in the midst of the muscle bundles.

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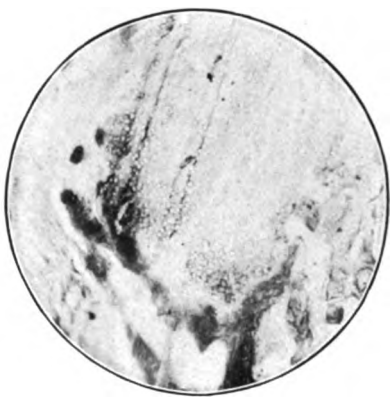

Fig. 3.—Myositis ossificans. This area typifies the process of metaplasia. Note the fibroblasts, cartilage and bony cells.

Fig. 4.—Myositis ossificans. Same as Figure 3. It shows the bony tissue more plainly.

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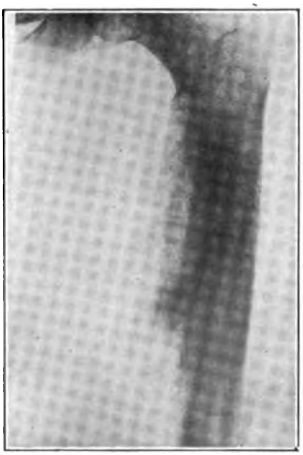

Fig. 5.—Mixed round and spindle cell periosteal sarcoma of the right femur having its origin on the inner side of the femur and extending into the adductor group of muscles. Anteroposterior roentgenogram made before operation. Note the radiating columns of bone sticking straight out from the femur through the tumor-like thick bristles. A roentgenologic feature characteristic of periosteal sarcoma. (From Clinics of John B. Murphy, February, 1915.) Compare with Figure 1.

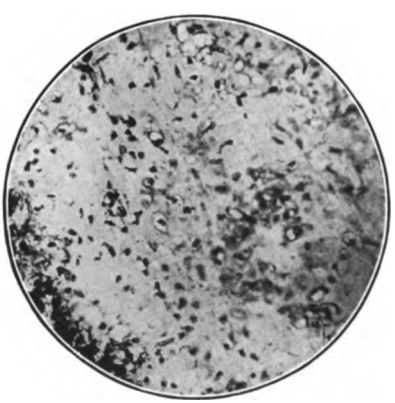

Fig. 6.—Mixed round and spindle cell periosteal sarcoma of the femur. This area shows cartilaginous metaplasia with calcium deposit at the extreme edge. (From Clinics of John B. Murphy, February, 1915.) Compare with Figures 2, 3 and 4.

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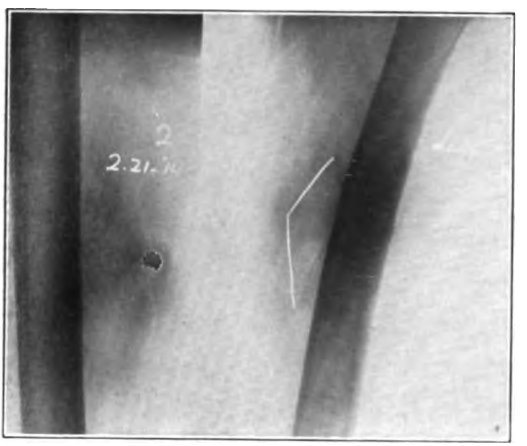

Fig. 7.—The bony material is seen projecting well into the muscular structure in the area enclosed by the bracket.

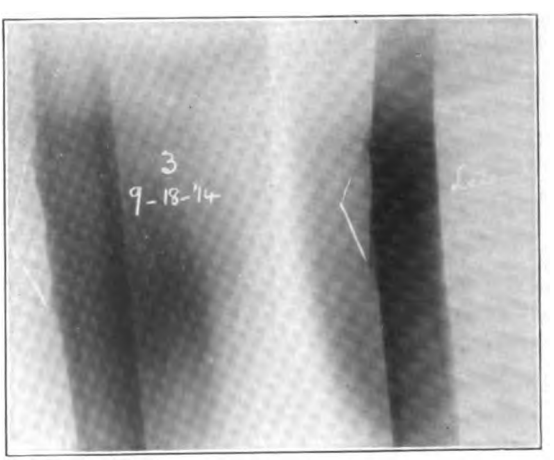

Fig. 8.—This roentgenogram, taken nearly nine months after the operation, shows considerable irregularity of the cortex of the femur in the area included by brackets.

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structure that they may encounter which acts like a limiting membrane. If we apply this pathologic principle to the subject under discussion, we must needs conclude that, given a closed injury to bony structure in a previously healthy individual sufficient to cause a proliferation of osteoblasts, and these in turn encountering no resisting structure to check their distribution, a bony deposit may result in any of the neighboring tissues, be they muscle tendon or fascia; whereas, in the case of an open injury involving the tissues named above, the migration of these fibroblasts toward the site of injury is not impeded. By making fine fibrillary connections with the cells nearby, they ultimately form the granulation tissue of healing wounds.

This, in brief, constitutes the difference in the pathologic sequences following a closed or open injury involving connective tissue structures. To this must be added the well-known fact that the power of regeneration is ordinarily greater in connective tissue cells than in any other form of cells in the body, and that this activity is greatly enhanced when stimulated by an injury.

The correlation of the data presented above, together with the clinical findings, form the basis of my theory for the causation of myositis ossificans by means of closed trauma, which, if true, will also hold good in those cases in which the supervention of sarcoma takes place.

With the survey of the etiologic character of the lesion to be dealt with, we come to the phase of the subject that is of most concern to the surgeon. What is the most appropriate method of treatment to be instituted in these cases? One cannot review even a small portion of the literature dealing with the treatment without being impressed with the divergent opinion held by a number of writers on this subject; however, the majority of writers favor excision as the method of choice. If my theory is correct, then

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there is only one way in treating these cases, and that is by the conversion of a closed into an open wound —a treatment adopted in all of my cases and fully described in the first part of this paper. Drainage should be instituted in every case and kept up until the tissues feel normal to the touch. The Roentgen ray will also aid in deciding when to allow the wound to close (Fig. 7). With these precautions, operative procedures will be followed by complete cure without the danger of recurrences (Fig. 8).

318 Commonwealth Building.

ABSTRACT OF DISCUSSION

DR. O. F. LAMSON, Seattle: Dr. Shere's paper is exceedingly interesting on account of the unusual pathologic conditions described. It seems to me, however, that in his paper he has confined himself to one type only. There are two types—the type which develops from a single severe injury, and the type which follows repeated injury, less severe. An instance of the latter would be injury to the deltoid muscle which soldiers have, also horseback riders, in the muscles of the thigh. In regard to treating these conditions as sarcoma, there is room for discussion. It is true that sarcoma often follows a severe single injury, but the fact remains in those cases operated on which prove to be true myositis ossificans traumatica that there has been no metastasis. There seems to be two different pathologic origins for this particular condition. One where in severe injury the periosteum is torn from the bone and results in the formation of bone in the muscular tissue, and the other where the fibrous tissue results in bone formation. I saw a case in Seattle in which there had been a tearing off of part of the periosteum which resulted in finger-like projections of bone into the muscle. In the treatment of this condition it is important that the patient be observed until there is no further progress in the growth; otherwise there will be a recurrence, and the removal of the growth must be complete. Dr. Shere's statement is that these cases always occur in closed wounds; this is probably due to the fact that in the closed wound where there is considerable hemorrhage there is more fibrous tissue formed from which the osseous change takes place. If this is a factor in the formation of bone in muscle, the early incision into the area with drainage, would be a prophylactic measure of great importance.

DR. DEAN LEWIS, Chicago: It is an interesting fact that traumatic myositis ossificans follows posterior dislocations of the elbow so frequently, and occurs after dislocations

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which have been reduced early. In this type of injury the periosteum is considerably stripped up, and the periosteal injury associated with this dislocation may account for the frequent development of myositis ossificans. The causes of the changes which lead to bone formation are not known. The changes in muscle and fascia which have been used to repair a defect in the ureter are very striking. Strauss has shown that the majority of fascial flaps used to repair defects in ureters become transformed into bone. I do not believe that there is any relationship between myositis ossificans and sarcoma. The diagnosis may be at times somewhat difficult, especially the histologic diagnosis, but in those cases in which a sarcoma has developed, the lesion was probably sarcomatous from the beginning. It is difficult to determine whether or when to operate. In many cases when let alone the bone gradually becomes smaller and may not interfere with function. I believe operation should be deferred in most cases until the bone has been considerably reduced in size. Undoubtedly the blood clot has considerable to do with the formation of the bone. I cannot agree with Dr. Shere in his early operation, for we cannot tell when myositis ossificans will develop. It certainly develops in but a small proportion of cases, and a routine operation would lead to needless surgery.

Dr. Alexius McGlannan, Baltimore: Pathologic new bone formation in the body may be an adaptation or some peculiar reaction to injury. We believe that myositis ossificans is a particular reaction to injury, just as keloid is due to injury to the skin, and therefore we believe it is not wise to operate early in the disease. If we wait in these cases the mass of bone shrinks and often does not require operation. In the early stage it requires a large operation. If operated on during the period when the tissues are forming bone, the traumatism will cause more new bone to form adding this to what is going on from the original injury.

Dr. O. M. Shere, Denver: I expected some antagonism to my theory of myositis ossificans, as well as to the treatment. The theory was not attacked, for which I am grateful. With reference to the comparatively early operation which I advocate in my paper, I believe I am justified on the grounds that the process appears to me to be a forerunner of sarcoma in a good many cases. In other words, it is presarcomatous. One would remove a mole or a wart from the skin for the reason that some of these growths become malignant in the course of time; the same principle holds true here because of the existing cases wherein sarcoma supervened on undoubted cases of original myositis ossificans. That is why I advise early operation.

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I cannot see any similarity between keloid and myositis ossificans. As to the rôle of the periosteum mentioned by Dr. Lewis, I can only reiterate what I have stated, namely, that the periosteum in these cases loses its function as a limiting membrane, and that the bony deposit in the affected muscles does not depend on the osteogenetic function which its inner layer may possess. I am only too well aware that it will take a great deal of time before we realize the true value of the distinction between open and closed injuries. The sooner that difference is appreciated by the profession, the better will be our conception of some of the malignant diseases which have thus far been the bugbears of the surgical profession.

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THE CASUALTIES OF MODERN NAVAL WARFARE

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Surgeon, U. S. Navy
WASHINGTON, D. C.

A consideration of the casualties and surgery of modern naval warfare were best approached by a brief review of ancient and modern naval battles, the implements used for the destruction of the enemy, and the character of the casualties inflicted. The means used for caring for the wounded would be almost a recital of the history of medicine and surgery.

The Bible, though replete with land warfare, beginning with the first battle described in Genesis xiv, 14-15, wherein Abraham had under his command a body of men for distinctly military purposes, fails to recount a single naval engagement, for the reason that the only two fleets enumerated (and also described in profane history) were designed for commercial instead of war purposes. Solomon controlled the Red Sea by reason of David's conquests, and only by consent of Solomon could the Tyrians pass through this sea. They had gained the mastery, but not the supremacy, of the sea. King Hiram of Tyre built and manned a fleet for Solomon, who sent it to Ophir for gold, from which port it safely returned. The Tyrians also built a fleet for Jehosaphat for the purpose of bringing gold from Ophir, but the ships were large and unwieldy and were broken up on the shore of Tarshish, a port of the Red Sea. Though possessed of military skill and with a knowledge of strategic maneuvering, they did not take kindly to the sea. They intuitively divined that which Hawkins derived

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from experience — that "The sea is naturall for fishes and the land for man." When the sons of Jacob came to sojourn in the land of the Pharaohs, the Egyptians were already expert in warfare and had a considerable army. A bas-relief from Thebes (period 1400 B. C.) depicts a naval engagement wherein the Egyptians vanquished the Indians. Herodotus describes Egyptian war galleys 126 feet long and 16 feet beam and writes that they were manned by the rowers and soldiers. These vessels had a raised poop, on which the archers were mounted, and had a metallic ram bow. They were built of strong acacia planks; ribs and knees and the masts were of fir. Xenophon give an excellent description of the Greek war galleys.

The stage of the simple missile weapon had no doubt passed before the first sea fight, but we find the dart, the javelin, and the spear of the missile type, and for weapons at close quarters, the cleaving axe, the crushing club, the thrusting sword or dagger, and the ram bow; and last, the discharging missile type, comprising the bows of the archers and the catapult. These were used in the earliest naval engagements and the wounds inflicted can readily be conjectured.

Greek legend relates that Minos, the Phenician ruler of Crete, sent out ships to free the Grecian sea of pirates; this was two generations prior to the siege of Troy and the Argonautic expedition. The sea coast had been devastated and nothing remained but a pirate village or the abode of a fisherman. Thucydides states that the oldest sea fight was that of the Corinthians against the Corcyreans. Their small and deckless craft were the origin of the valorous Grecian navy, which with a much inferior force vanquished the great Persian fleet of Xerxes, numbering 1,207 vessels of war, exclusive of the transports, having a complement of 241,000 men, in 480 B. C., between the island of Salamis and Attica, the first decisive naval battle of the world's history. In Herodotus' account of the

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battle he describes the Persians as healing the wounds of the brave Grecian, Pytheas, with myrrh and binding them with flaxen cloth.

At the battle of Actium, 450 years later, Antony's fleet of 200 heavy vessels armed with the heavy artillery of that period, was set on fire by four fire-ships and destroyed. The great loss was from drowning and burning.

Rome maintained an imperial navy as a part of her military establishment. A tablet was found on the Elysian fields, in the vicinity of the Pontus Julius and the station of the imperial fleet, erected to the memory of M. Sartorius Longinus, physician to the *Cupid,* a three-banked ship. When it is considered that the complement of men in the ships of this period was about 480 it is probable that medical men accompanied navies as well as armies.

Passing to the sanguinary battle of Lepanto in 1571, wherein the states of the Mediterranean united against the Turks, and 273 Turkish vessels engaged 208 heavier Christian vessels, the Turk force of 20,000 men was almost all sunk or driven ashore. In the engagement the Christians were armed with cannon and small arms, but the Turks relied principally on bows and arrows. "The arquebusier, the musketeer, and the bombadier of the Christian force looked carefully to the state of their weapons and equipment and the surgeons prepared their instruments and bandages, and spread tables in dark and shaded works for the use of the wounded." In the conflict 20,000 Turks were killed, largely by fire arms, and 8,000 Christians perished by the arms and cuirasses of the Turks. On Cordona's galley "the masts and spars were stuck full of arrows" and 450 out of the 500 Sicilian soldiers were killed. Cordona received a wound in the throat, of which he died. Lepanto, which spoke the doom of Turkish naval power, was the last European battle in which a commander used the crossbow.

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Seventeen years later came the defeat of the Spanish Armada — 32,000 Spanish on 132 vessels, and 17,000 English on 197 vessels, generally smaller (although the *Triumph* was 1,100 tons). The fire-ships played an important part for the English in this conflict "with almost equal effect to that of the fire-ships which the Greeks so often employed against the Turkish fleets in their war of independence."

In Nelson's great victories, the Nile and Trafalgar, the French casualties were appalling, especially during the Nile engagement, wherein the *Orient* caught fire and exploded. In this battle, of the 11,000 persons in the French fleet, but 6,000 returned to France.

Passing to our own naval battles, in the first American victory in the engagement between the *Bon Homme Richard* and the *Serapis* we find a high casualty rate. Jones gave the wounded on board the *Serapis* as more than a hundred, and the killed probably as numerous. Of the wounded, thirty-three were said to have been "miserably scorched," doubtless by the explosion of the cartridges on the main deck. This means a casualty list of nearly 70 per cent. The *Richard* had forty-two killed and forty wounded, a total of 25 per cent. "Two of the three eighteen pounders in the *Richard's* gun room burst at the first fire, spreading around an awful scene of carnage," writes Slidell. "The three American guns which remained in commission were double shotted and loaded with grape and canister to clear the enemy's deck. From the *Richard's* tops and yard arms, hand grenades were dropped setting the *Serapis* afire many times. One of these set fire to a number of cartridges, which exploded and killed twenty men at the guns and stripped the remainder of their clothes, burning them frightfully."

The American sailors during the Revolution were better marksmen than the English. Trained in the backwoods to take aim before firing, they practiced these tactics with their batteries, while the English fired

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point blank. They also used carefully aimed, slow moving, heavy balls, which splintered the wooden sides of their opponents, annihilating whole gun crews with the resultant shower of splinters. "This is how the *Wasp* demolished the *Frolic* in forty-three minutes, and the *Hornet* demolished the *Peacock* in just eleven." At the battle of Lake Erie, as the result of the concentration of the British fire on the *Lawrence,* out of a crew of 101 there were eighty-three casualties. The guns used in the engagement ranged from four to twenty-four pounders.

During the Civil War, one half of the *Cumberland's* crew perished when the iron prow of the *Merrimac* rammed her. At the same time a raking fire of shells was poured into the Union frigate's side. "The battle of the afternoon had ended the day of wooden navies." In the battle of Santiago 353 of the Spanish were killed or drowned and 151 wounded. At Manila Bay the Spanish casualties were 167 killed and 214 wounded. At the battle of the Sea of Japan 4,000 Russians perished and but 116 Japanese were killed and 538 wounded.

From Sanoyeshi and Suzuki, of the Japanese navy, we have detailed accounts of the casualties of the naval war between Japan and China, and from Suzuki, Totsuka, and Braisted, those of the Russo-Japanese war; and from Medical Director C. F. Stokes, former Surgeon-General of the United States Navy and Surgeon Don Juan Redondo of the Spanish navy we had the same of the Spanish-American war. These different reports agree generally as to the gross lesions, and from them the following summary is drawn.

The hollow steel shell, with its conical point and its interior mechanism, which causes detonation on impact, ignites the large bursting charge, causing a comminution of the steel, producing a conical shaped shower from the point of disintegration, in consequence of its mass momentum. Added to this is every object struck by the fragments, which becomes a secondary

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missile. These may be wooden or metal objects—a splintered door or a bursting steam pipe. Shell fragments are irregular in size and form, with roughened and sharp edges. They retain so much heat that the tissues in which they lodge are seared. Their velocity is relatively low.

Wounds occasioned by shell fragments, or by the secondary missiles caused by shell explosions, will naturally vary according to the size, form, momentum and gyration; the difference in the tissue affected is even greater. Laceration is the common characteristic of all lesions, whether the tissue be soft or bony. Great extent, multiplicity, and the frequency with which missile fragments and portions of clothing are carried into the wound are other happenings. The wounds of entrance are generally smaller than those of exit, but the reverse condition sometimes happens. As Suzuki remarks, "This phenomenon and others are hard to explain." He found cavities of blind wounds with comparatively small inlets containing fragments of shell several times larger than the wound itself, wounds of only one orifice, in which no fragments of shell or splinters could be found lodging, even with the Roentgen ray, and at postmortems others were found, the presence of which could not be accounted for.

Multiplicity of wounds is usual; there may be more than a hundred wounds from one shell in a single individual. The different wounds on the individual will vary widely in character. The majority of the wounds are blind, and as compared with bullet wounds, perforations are relatively few, this being the result of the decreased velocity. Troublesome hemorrhage is rarely produced, even though the wounds be large and in several parts of the body, although there is great injury from extensive wounds. In mutilated wounds of the limbs the blood vessels were frequently cut through, with but few cases of hemorrhage, owing to the retraction of the severed ends. Fragments

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often pass close to the blood vessels without injuring them. Comminution of a bone generally results when small fragments strike it; yet at times the bone is merely fissured or chipped off. Traumatic aneurysms are common. The shell fragments may be lodged at any depth and involve every structure of the body. The bursting steam pipe or exploding boiler, perhaps complicated by displaced ashes, will cause every variety of burn. Concussion of the brain and rupture of the membrana tympani are frequent occurrences.

With reference to the infection of wounds from shell fragments the majority of observers report that infection is general. Redondo states that wounds in naval battles, in the great majority of cases, are not, and cannot be, aseptic wounds in which we hope for quick healing under the simple first-aid dressing applied on the instant, and Stokes concluded, "It is not surprising that they are so commonly infected when we consider the extent of contused and lacerated surfaces exposed to contaminating influences." Both these observers wrote from conditions observed during the Spanish-American war in 1898. Suzuki is more optimistic; he writes: "Shell fragments are generally antiseptic. Wounds of small shell fragments generally heal by primary union. When suppuration occurs examination should be made for the presence of foreign bodies, which once removed, wounds heal quickly." These conclusions are from observations during the Russo-Japanese war of 1904-1905. Suzuki, however, remarks: "Even in peace complete asepsis is a difficult matter of attainment on board ship. During an engagement it is ten times more difficult. During the firing of guns, the hastening to and fro, and a thousand other things that fill the air around the temporary surgery with dust and particles of matter, a number of wounded cases are brought in, each demanding immediate attention, and asepsis is impossible." Two other valuable remarks of this careful observer are that cov-

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ering the wounded surface with skin is a good protection to it, and in cases of compound fractures, free segments of bone in the cavities should be extracted, but if not completely detached, they should be permitted to remain in the cavity.

The comparative frequency of wounds with reference to the parts of the body involved vary with different observers. During the Russo-Japanese war, of 2,164 wounds reported by Suzuki the following percentages are recorded:

Lacerated wounds	32
Contusions	21
Abrasions	10
Blind wounds	10
Burns and scalds	6
Multiple wounds	6
Concussion of labyrinth, rupture and congestion of tympanic membrane	5
Perforated wounds	5
Pulverized wounds	2
Wounds with loss of soft tissue	2
Incised and punctured wounds	1

The difference between wounds inflicted during naval battles and those on shore is due to the fact that about 90 per cent. of those on board ship are the result of shell fragments, and of those of land warfare 90 per cent. are inflicted by bullets of small caliber, high velocity and penetrative force. An examination of the available reports of the present war from British naval hospitals, and from the naval action off Heligoland, in the North Sea, and at Zanzibar shows no change in the relative per cent. of casualties from shell fragments from that in previous naval wars.

In wounds from small caliber bullets, at times both the wound of entrance and exit are located with difficulty. The present war has not altered the status. Osler remarks, as a result of his observations of wounds of this character in the present war: "They illustrate the inefficiency of the modern rifle as a weapon of war." Of nine wounds of the chest, seven

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were complete perforaticns with bullets, one shrapnel bullet lodged in the lung, and one fragment of a shell had also penetrated the lung. "These men had been wounded within a fortnight, yet all were up and about, without fever, practically without cough or other symptoms, and with very few physical signs." The wound of entrance in all was small and healed, the wound of exit a little larger and healed. "The death rate in the Spanish-American war was 27 per cent., while in the Japanese war in 927 cases, it was only 3.67 per cent." The mortality in the present war may be still lower. The observations of Alexis Carrel are to the same end. The Berlin observations are also corroborative.

Medical Inspector Gravatt of the United States Navy reported that during the battle of Santiago, when a competent first dressing was applied, wounds did remarkably well, notwithstanding unfavorable surroundings. He also stated: "One of the most practical lessons taught by the war, ashore and afloat, and about which all observers are agreed, is the importance of a competent first-aid dressing in preventing wound infection."

Surgeon C. M. Oman, United States Navy, recently wrote: "It can be prophesied with assurance that most wounds of naval warfare will suppurate, but with liberal use of iodin this ought to be less marked than in former battles." In view of the great efficiency of iodin in emergency surgery in civil life all agreed in this optimism, and it is as discouraging as it is astonishing to note the following from the "Preliminary Report of a Committee Appointed by the Director General of the Medical Department of the (British) Navy, in December, 1914, to Inquire into the Best Method of Treating Wounds Sustained During an Action, Especially During the Early Period After Their Infliction." The report was published April 1, 1915, and its committee membership is Sir

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Watson Cheyne, Fleet Surgeon, P. W. Bassett Smith, and Mr. Arthur Edwards, F.R.C.S.—all eminent names in the British medical and surgical world.

The report contains this sentence: "*Many of the wounds which have been treated with iodin are amongst the most septic which we meet with.* It is quite clear from all these facts that iodin is useless for the disinfection of wounds in war, or for inhibiting the growth of bacteria in wounds." The provisional recommendation of this committee is: It is proposed to recommend this combination (salicylic acid and boric acid in equal parts) to the navy in the form of pepper pots (pepper shakers) containing about 1 ounce each, and of paint tubes (collapsible tubes) containing ½ ounce of 20 per cent. cresol paste (in lanolin and wax base) the tubes being provided with a nozzle about 2 inches in length, which are screwed on the ends of the paint tubes, so that they can be introduced into the depths of the wounds in various directions. This tube should be used on only one patient and then thrown away. In the ships a sufficient quantity would be issued to deal with the probable number of wounded; in the case of a naval contingent acting on shore each man would have a pepper pot and a tube in his field dressing. In case of a wound at the front the first thing is, of course, to stay the bleeding as much as possible, and then to powder the whole surface thoroughly. The cresol tube is then introduced into the wound and small quantities of the contents are squeezed into it in various directions, endeavoring, as far as possible, to leave small portions of the paste scattered over the whole surface of the wound, not more than 1 inch apart. Some of the paste should also be smeared over the skin around the wound, and after a final dusting of the borosal powder, the emergency dressing is applied. This can be done quickly and the patient can wait till such time as the wound can be more thoroughly attended to.

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For many years medical officers of the different navies were at considerable variance as to where the battle dressing-station should be located, and also as to what activities should be attempted by the medical and hospital corps during action. In our latest super-dreadnaughts there will be two battle dressing-stations on each vessel, entirely behind armor. Beginning with the battle ships authorized in 1898, all our larger vessels and many of the smaller are provided with a fully equipped operating-room, dispensary, and hospital (sick bay). Quoting Medical Inspector Thomasuri of the Japanese navy: "In the older warships, constructed originally without provision for special distributing stations, it is often found that the position of a temporary distributing station has been settled on the eve of an action or engagement. Thus during the Chino-Japanese war in 1894 and 1895, the Japanese warships used the officers' wardroom as a dressing-station, and owing to its exposure to the fire of the enemy the *Hiyei* had her dressing-station destroyed at the beginning of the battle of the Yalu. The entire medical staff and all those who were at the moment in the wardroom were killed or wounded." In the days of Nelson the wounded were carried to the cockpit. "The surgeon is placed in the hold, where he should be in no danger of shot, whereby they will be deprived of all help for hurts of wounded men." This was the procedure of that period. All such questions have been disposed of after years of consideration and all such questions are provided for in the recently issued "Manual for the Medical Department of the United States Navy." In equipment and preparation no navy in the world is better provided for. Hypothetic casualties are cared for at drills and general quarters, the routes of transportation to dressing-stations and the compartments of the ship are constantly studied. Medical officers are detailed to the Naval War College, as Surgeon General Braisted stated: "To study

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most carefully the plans of the proposed operations, and to familiarize themselves from the military standpoint with the demands that will be made and so to prepare and equip that the campaign may not end in defeat and disaster on account of a personnel overcome by disease and disability."

Naval warfare is evolutionary, hence its casualties will be varied. The present conflict has not varied materially from the calculations of many naval strategists, except possibly in the extent of submarine activity. If two navies of equal, or nearly equal, strength were engaged in a contest for the supremacy of the sea, or to land an expeditionary force, and an engagement between superdreadnaughts, or composite fleets of superdreadnaughts, battle cruisers, and destroyers, we would anticipate a different type of casualties than has occurred in the present war, principally in the diminished ratio of deaths from drowning. But excluding this single cause of death, all other casualties may be anticipated, and in some measure provided for.

The following is the "Detailed Organization for Relief of Wounded Aboard Ship" in the United States Navy, to which previous reference was made:

> The regulations require that the medical officer shall frequently advise the divisional officers in the use of the first aid appliances. These include shell wound dressings, designed to occlude and protect the wounds caused by shell fragments, and tourniquets for the control of hemorrhage. In addition, instructions in resuscitation of the apparently drowned are given. The divisional officers in turn give instruction to the men under their immediate command. The medical officer also provides for the instruction in first aid and transportation methods of the hospital corps and stretcher men in number equal to about 2 per cent. of the complement of the ship. Turrets, handling rooms, gun stations, torpedo, fire and engine rooms, and fire control stations and other stations not readily accessible, in which men and officers are stationed in battle, should be provided with first aid appliances. Dressings for burns and scalds in engine and fire rooms, plainly labeled, should be accessible to the occupants of these stations.

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Modern naval warfare presupposes a high casualty rate and a rapid accumulation of the wounded, but the casualty rate will vary widely on different ships, probably being the highest in the leading divisions. Any effective organization of medical personnel to meet the demands of the wounded in a naval engagement will usually go beyond the facilities of a single ship and will necessitate the adoption of a more comprehensive scheme of assistance external to the ship, but every vessel should be self-sustaining as far as practicable, and no effort should be spared to attain this end. When wide dispersion of the ships or other conditions render outside assistance unavailable, the measures to be adopted by the ship's resources alone during and subsequent to battle will comprise the following:

Continuous first aid to the wounded during battle on the part of the personnel at large. The effectiveness of this service will depend largely on the thoroughness with which the units have previously been instructed by the medical and division officers, as required under the regulations, and how well they have become imbued with the principle that first aid, calmly administered by themselves or comrades, represents the maximum service that can be rendered the wounded during the height of a naval action. The ship's force should have been warned that elaborate measures of treatment or extensive transportation during battle are inadvisable and impracticable. The wounded man after the administration of first aid, should be placed to one side where his presence will be the least felt, and where he will not incommode or disturb the fighting force.

In a suspension or lull in the battle, or after the engagement upon notice from the central station, and when prompt treatment of the wounded in or near the fighting position is denied or deferred for any reason, the stretcher men may be required to seek out and transport certain of the wounded to the battle dressing stations. It should be the first duty of the medical officer to give attention to such of the wounded as may render further service at the guns or elsewhere after the application of the appropriate treatment. These men should be promptly returned to their stations. It must be borne in mind that the primary purpose of first aid is to keep as many effectives at their stations as possible. A graver class of injuries may require deliberate surgical intervention, but extensive procedures on the part of the ship's force are only legitimate if evacuation of the wounded, for any reason, is delayed or rendered inadvisable. The personnel of the Medical Department should institute a search for the seriously wounded to afford them relief and to prepare a list of the dead as soon as practicable. To assure the wounded early and efficient treatment, effect their rapid

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removal from the fighting ship, and insure a continuous record of each case is the object of the organization.

General Quarters: When at exercise simulating action (in so far as it is possible to do so) the medical officer will employ this opportunity to instruct the personnel of the dressing stations in their duties, insuring himself that all members of the ambulance party are competent to administer first aid; that they understand their stations and the limits of the ship assigned to them, and the usual routes of transport to and from the groups of personnel. At drill the dressing stations will not be equipped in advance of the signal "general quarters."

Battle Dressing Stations: Battle dressing stations should be easy of access and located behind armor. Routes to the dressing stations should be indicated by an arrow and a red cross. There should be at least two, one installed as a main or primary dressing station, and one as an accessory or secondary station. The stations should have an abundant supply of drinking water, all connections being installed behind armor. As these connections might nevertheless be interrupted, storage tanks for drinking water should be provided, having a capacity sufficient to furnish in first-class ships 1 gallon of water per man, allowing for 20 per cent. of wounded. Dressing stations should also be well ventilated and well lighted, and as cool as the surroundings will permit. It has been estimated that each 36 square feet of area should be provided with one cargo light of approximately 200 candlepower (six lamps). If possible, connections for electric lights should be distributed on two circuits; lanterns or some other means of lighting should be available in case the electric lighting circuits suffer interruption. Electric or steam connections should be provided for the water and instrument and dressing sterilizers. In ships wherein proper connections are provided, sterilizers should be removed from the surgical operating room and set up in the main dressing station prior to the action. When so installed they should remain during the period of hostilities. If possible there should be some provision made for the drainage of this space. In the vicinity of the dressing station or adjoining it there should be arranged a berthing space for the wounded sufficient to accommodate about 10 per cent. of the complement. This space should be easy of access from the dressing station, and like the latter, have an abundant air supply. In addition to the usual equipment transferred from the sick bay and operating room and distributed in the dressing stations, the following articles should be provided: electric fans with proper connections; half tubs; water buckets; swabs and brooms; washing stands; tables for apparatus; shelves; supports or hooks for irrigators; dressing lockers; bedding for the berthing space for wounded; restoratives, etc. A reserve

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supply of surgical dressings should be available on this deck in a secondary station, behind armor and accessible for distribution to the dressing stations if required.

The station of the medical officer of the ship during action will, as a rule, be at the main (operating) dressing station, where he will see that the necessary equipment is provided.

Preliminary to battle the personnel should be required to bathe and put on clean underclothing.

Means of identification of the dead should be provided for each officer and man.

The organization of the Medical Department, showing all the dispositions under battle conditions, should be worked out for the ship as soon after going into commission as practicable. Provisions should be made for the instruction of officers and men in first aid as described above; and for a definite organization of the personnel of these stations, as well as for their progressive instruction in first aid and transportation methods. During action the difficulties of transportation preclude any extensive exercise of the functions of the stretcher men, and as their most important duties are to be performed after the action is over, or during intervals of action, they will avoid exposing themselves unnecessarily. Such emergency work as is feasible will be performed.

The galley and bakery of ships of old types if intact after the engagement may be placed at the disposition of the medical officer for preparing additional hot water and dressings and for sterilizing instruments.

Operating Room: If not dismantled, the ship's operating room may be made use of after the action to supplement the work of the dressing stations, provided the removal of the gravely wounded direct to hospital ships is not feasible.

Transportation of Wounded: Apparatus will be provided by the medical department of the ship for the transportation of the wounded, but complicated appliances liable to displacement will be avoided. Simple measures designed to facilitate transporting wounded by stretcher directly to the dressing stations by the most convenient hatch, down which they will be lowered or passed by hand to the deck below, or over the side to boats from the hospital ship, are to be preferred to more elaborate means of transport.

A suitable place should be assigned for the disposition of the dead.

When the medical transport or hospital ship is at hand the seriously wounded should be transferred as promptly as is consistent with their welfare. A fighting ship should be cleared of such cases as soon as possible after an action, in order that she may be ready to reengage in battle. On the other hand, patients who will probably soon be fit for duty should be retained on board, and these may constitute a large proportion of all cases.

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There would seem to be no great difficulty in teaching men of the mentality of a navy such as ours to properly apply a first-aid dressing, and experience has demonstrated that there is none. When the individual applies his first-aid dressing self-preservation will inspire him to do it properly. When it is impossible for him to apply it all that is needed on the part of his comrades, in addition to proper instruction and equipment, is presence of mind. Notwithstanding the instructions furnished Japanese sailors during their last war, Surgeon General Suzuki said he was somewhat disappointed that the wounded had not carried out his instructions more carefully. About one third of the wounded did apply, or had applied, the first-aid before coming to the dressing-station; the remainder simply grasped the wounded portion or member and came to the dressing-station.

All will agree with Volkmann, "The fate of the wounded rests on the hands of the one who applies the first dressing."

The effects of powder-gases and smoke is a cause of serious concern during a naval battle. The powder in shells is composed of nitroglycerin, gun cotton, nitrocellulose, and a deterrent; the combustion products include CO and NO_2. "From the composition of powder-gases," writes Stokes, "it is evident that we shall have two types of poisoning; one resembling illuminating gas poisoning, the other irritative in its effects. A larger dosage of powder-gas may lead to unconsciousness and death." A shell exploding in a closed compartment is more serious than one in the open air, on account of the concentration of the gases. Spear writes, "The fumes from bursting Shimose shells in closed compartments had the effect of making the men exposed weak and nauseated and causing a sensation of weakening, without a loss of consciousness. Some of these men recovered quickly; others took days before all symptoms had disappeared."

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Stokes concludes, "It is probable that the undue proportion of prostration attending shell wounds, formerly attributed to shock, is really due in part, at least, to gas poisoning and not to injury alone." In this connection, the following extract from an account of "Wounded Treated at the Royal Naval Hospital, Shotley," by Fleet Surgeon L. W. Burton, R. N., is interesting (out of 197 severe cases there were eleven cases resulting from the inhalation of lyddite fumes, two resulting fatally):

> I could see no difference, clinically, between the effects produced on German seamen by the inhalation of fumes from lyddite shells and on our men from the fumes of the German mines, so I suspect the noxious gases produced by the explosion in both are very similar, and that the effect is due mainly to nitrous fumes, such as are given off by the burning, not detonation, of almost any of the nitro explosives. These cases proved the most insidious and most rapidly fatal of any which came under treatment. Patients who were apparently suffering very little inconvenience on admission rapidly became asphyxiated and died within twelve or twenty-four hours, with all the symptoms of an acute capillary bronchitis or bronchopneumonia, which evidently resulted from the irritant action of the fumes on the vesicles and mucous membrane of the bronchioles. They first complained of some pain and tightness around the chest, which gradually became worse and was accompanied by cough, marked dyspnea, and the expectoration of blood-stained frothy mucus. As the minute tubes became more and more aggravated and violent, efforts were made to aerate the blood, as was seen by the sucking in of the suprasternal, supraclavicular and intercostal spaces with each breath. Respiratory distress became more and more marked as the inspiratory efforts became less effectual, and the patient gradually passed into a state of coma, and finally became quite unconscious. The heart beat feebly for some time after respiration ceased, and after death a copious discharge of blood-stained frothy mucus from the mouth and nostrils continued. As regards the treatment, there is little to be said. Some temporary benefit resulted from the use of oxygen and the bronchitis kettle, but no medicines tried seemed to retard the rapidly fatal progress.

Staff Surgeon Hewitt, R. N., in his "Report on the Casualties in Action Between the *Pegasus* and *Konigsberg*," states: "The fumes of the high explosive powder used seem to have a sickly, stupefying effect and per-

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haps cause a feeling of dizziness, but those may have been due to concussion. I, personally, had been breathing more deeply than normal in assisting a wounded man up a ladder from the torpedo flat, where the fumes were particularly dense, and experienced a feeling of nausea and dizziness. For several days after, on deep breathing, one seemed to exhale the same fumes. Others were affected in a similar manner." Surgeon Hewitt was wounded in the action.

The menace of smoke may be appreciated when it is deemed necessary to protect the smoke stacks of the new superdreadnaughts with 13-inch armor. The supply ventilating apparatus of a warship cannot be operated during an action on account of the danger of forcing products of combustion into the interior of a ship. Nothing more disconcerting could happen than the perforation of a smoke stack in any part from which the smoke would pour into the occupied spaces.

From the foregoing it is evident that the surgery of naval warfare of today, other than first-aid and emergency measures, must be most conservative until action has entirely ceased. The conservatism disappears partially with the cessation of action, and before the arrival of the hospital ship or transport, and not absolutely until the sanitary base is reached. Chloroform must be the anesthetic, on account of its rapidity. Shattered limbs will require amputation, and collapse from abdominal hemorrhage may require laparotomy. Severed nerve ends must be united and dyspnea from throat wounds and depressed fractures should be regarded as surgical emergencies. The immobilization of fractures and search for foreign bodies should be performed as expeditiously as circumstances will allow, until roentgenoscopy is available. Burns, even the most extensive, require picric acid in saturated solution applied with thick layers of gauze kept well moistened. For shock, morphin in half-grain doses, fresh air and physiologic salt solution should be used.

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The cause of the greatest number of deaths during naval warfare is the same as during peace, namely, drowning. During the Russo-Japanese war out of a total of 1,891 deaths in the Japanese navy, 1,445 were from drowning. During the engagement off the Falkland Islands, between the British and German fleets, of a total complement of 2,177 on the *Scharnhorst, Gneisau, Leipzig,* and *Nurnberg,* the British Admiralty reported "only a few saved." The casualties in the British navy, from the beginning of the war up to March 18, 1915, were 6,668. Most of these were probably from the sinking of Admiral Cradock's fleet off the coasts of Chile, and that of the *Cressy, Aboukir, Hogue,* and *Hawke* off the European coast.

Submarines, which have proved so efficient in offensive operations during this war, have many elements of danger to their crews. P. A. Surgeon W. H. Halsey, U. S. Navy, from experience with this type of craft, summarizes, to wit:

The dangers from without may be from striking an obstruction when running submerged, striking an obstruction when coming to the surface after a submerged run, diving to too great a depth to be able to acquire sufficient buoyancy to come to the surface, as for example by reason of an abrupt dive, leaks in the water-tight body of the boat and vitiation of the air in the boat due to constant rebreathing and the running of the engines with the batteries on a long submerged run, or when it is impossible to come to the surface.

The dangers from within comprise gasoline poisoning in the gasoline type of boat, which may occur from breathing the fumes of the raw or burned gas and demonstrates itself in various forms of nervous excitation. Wild delirium is frequently seen in gasoline poisoning, and sometimes coma of the profound type. Poisoning by hydrochloric acid gas, from leaks into the battery tanks, may occur. The electrolyte is sul-

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phuric acid and when salt water leaks into it hydrochloric acid gas spreads through the boat with great rapidity; men are overcome by the gas almost instantaneously. There is a coughing, choking and gasping for air, and then collapse. Battery explosions sometimes occur, due to the rapid combination of the nascent battery hydrogen with oxygen; this is usually due to defective battery ventilation. Back fire in the gasoline exhaust, sometimes due to ignition of unburned gases in the exhaust, frequently occurs.

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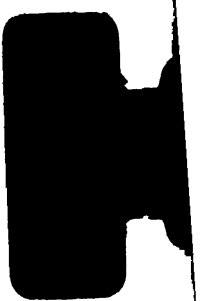

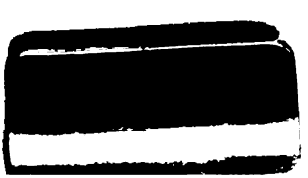

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